COLLINS

maintenance manual

(with installation data)

Cedar Rapids Region | Collins Radio Company, Cedar Rapids, Iowa

860E-2
Distance Measuring Equipment

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The equipment described herein is sold under the following guarantee:

Collins agrees to repair or replace, without charge, any equipment, parts, or accessories which are defective as to design, workmanship or material, and which are returned to Collins at its factory, transportation prepaid, provided:

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INFORMATION NEEDED:

(A) Type number, name and serial number of equipment
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(C) Date placed in service
(D) Number of hours of service
(E) Nature of trouble
(F) Cause of trouble if known
(G) Part number (9 or 10 digit number) and name of part thought to be causing trouble
(H) Item or symbol number of same obtained from parts list or schematic
(I) Collins number (and name) of unit sub-assemblies involved in trouble
(J) Remarks

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(B) Collins part number (9 or 10 digit number) and description
(C) Item or symbol number obtained from parts list or schematic
(D) Collins type number, name and serial number of principal equipment
(E) Unit subassembly number (where applicable)

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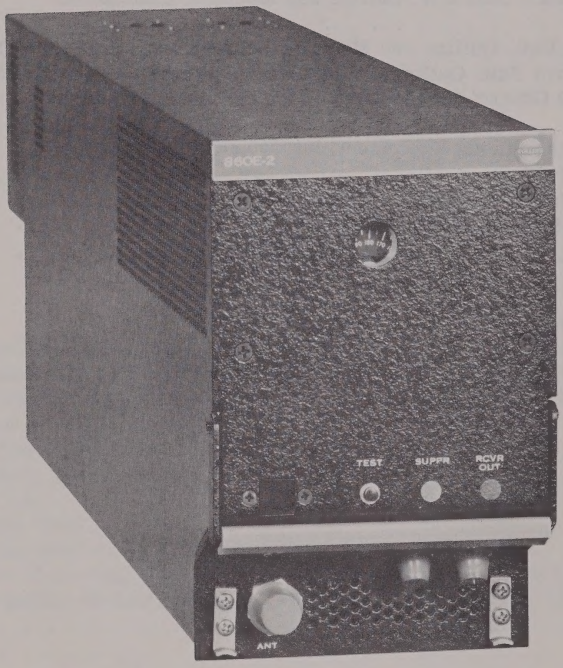


860E-2 Distance Measuring Equipment
Figure 1

860E-2 Distance Measuring Equipment - Description and Operation

1. GENERAL.

A. Purpose of Manual.

This manual provides the information that is required to install and maintain the 860E-2 Distance Measuring Equipment. Included is a description of the equipment, a general theory of operation, preinstallation testing procedures, installation and cabling information, and trouble-shooting and maintenance procedures that can be performed by line maintenance personnel. The 860E-2 is shown in figure 1. A list of the equipment covered in this manual is given in figure 2.

COMPONENT	WEIGHT (lb)	COLLINS PART NUMBER
860E-2 Distance Measuring Equipment	37.0	522-2702-00
237Z-1 Antenna	0.19	522-2632-00
349D-3B Shockmount	2.25	522-2144-004
614U-7 Control Unit	1.9	522-1473-00
614U-8 Control Unit	1.9	522-1474-00
313N-2D Control Unit	2.25	522-2447-025 or 522-2447-035
313N-3D Control Unit	2.25	522-2448-025 or 522-2448-055
313N-4D Control Unit	1.2	522-3616-00
339D-1 Distance Indicator	1.1	522-1859-003
339D-3B Distance Indicator	2.0	522-2919-00
339D-3C Distance Indicator	2.0	522-2920-00
339D-3D Distance Indicator	2.0	522-3343-00

Table of Equipment Covered in this Manual
Figure 2

B. Purpose of Equipment.

The 860E-2 Distance Measuring Equipment electronically measures the line-of-sight distance from an aircraft to a fixed TACAN or VORTAC station. The transmitter portion of the 860E-2 randomly transmits shaped and coded interrogation pulses. These pulses are received by the ground station which then transmits reply pulses. These reply pulses are received by the receiver portion of the 860E-2. The computing circuits in the 860E-2 measure the round trip travel time, or the interval between interrogation and reply pulses, and convert this time to electrical signals to drive the distance indicator.

C. Other Publications Available.

Figure 3 lists the other publications concerning the 860E-2 and associated equipment.

PUBLICATION	COLLINS PART NUMBER
860E-2 Distance Measuring Equipment	
Overhaul Manual	523-0755913
Illustrated Parts Catalog	523-0755914
Pilot's Guide	523-0755915
Question and Answer Manual	523-0755916
Control Units	
313N-2 Instruction Book	523-0754001
313N-3 Instruction Book	523-0752001
614U-7/8 Instruction Book	520-5963001
313N-4/4A/4B/4C Instruction Book	523-0756631
Indicators	
339D-1/3B/3C/3D Unit Instructions, Maintenance	523-0755287
339D-1/3B/3C/3D Unit Instructions, Overhaul	523-0755288
Antenna	
237Z-1 Unit Instructions, Overhaul	523-0756146

Table of Other Publications Available
Figure 3

D. Options and Variations.

The 860E-2 is available in the seven different models listed in figure 3B. The kits listed in figure 3A are also available for modifying the 860E-2. Internal wiring changes, described in detail in 860E-2 Overhaul Manual, will provide the following alternate performance features: (1) Static memory instead of velocity memory, (2) Fast flag instead of slow flag, (3) ILS and TVOR channels always overridden, or ILS and TVOR channels overridable, or ILS channels overridable and TVOR channels always overridden instead of ILS channels not overridable and TVOR channels overridable.

KIT DESCRIPTION	COLLINS PART NUMBER
Elapsed time meter	554-6308-00
Power relay	974-0839-00
12.5-mile trip switch	554-7220-00
Internal 27.5-volt dc power supply	554-6307-00
Computer potentiometers	381-1497-00

Table of Optional Kits Available
Figure 3A

COLLINS PART NUMBER	FEATURES														
	SIGNAL CONTROLLED SEARCH	SELF-TEST	VELOCITY MEMORY	SLOW FLAG	SPLIT CHANNEL ACTIVATED	ILS CHANNELS OVERRIDABLE	TVOR CHANNELS OVERRIDABLE (X) OVERRIDDEN (XX)	POWER RELAY	27.5-VOLT POWER SUPPLY	COMPUTER POTENTIOMETERS	12.5-MILE TRIP SWITCH	ELAPSED TIME INDICATOR	200-MILE MAXIMUM RANGE	300-MILE MAXIMUM RANGE	200-MILE OVER-RIDABLE TO 300 MILES
522-2702-014	X	X	X	X			X						X		
522-2702-052	X	X	X	X	X	X	XX	X					X		
522-2702-053	X	X	X	X	X	X	X						X		
522-2702-054	X	X	X	X			X	X					X		
522-2702-056	X	X	X	X			X					X	X		
522-2702-058	X	X	X	X			X			X				X	X
522-2702-060	X	X	X	X			X			X	X			X	X

Table of Available Models and Features
Figure 3B

2. EQUIPMENT SPECIFICATIONS.

Figure 4 is a list of the specifications on the 860E-2 Distance Measuring Equipment.

CHARACTERISTIC	SPECIFICATION
TSO	C66 category B.
Size	JAN A-1D (1/2 ATR) (7-5/8 x 4-29/32 x 24-3/32 inches).
Weight	37 lb (37.2 lb for 860E-2 having 300-mile distance mechanism module Collins part numbers 522-2702-058 and 522-2702-060).
Temperature	
Operating	-40°C (-40°F) to +55°C (+131°F) to +70°C (+158°F) for 30 minutes.
Storage	-65°C (-85°F) to +55°C (+131°F).
Humidity	Sensitivity and power output requirements are met when the unit is tested per RTCA paper 100-54/DO-60, section II.
Altitude	35,000 feet when tested in accordance with RTCA paper 100-54/DO-60, section I, procedure B.
Shock	15 g when tested in accordance with RTCA paper 100-54/DO-60, section V.
Vibration	10 to 55 cps when tested in accordance with RTCA paper 100-54/DO-60, section VI.
Low-voltage operation	The 860E-2 meets the requirements of RTCA paper 100-54/DO-60, section VII.
Power requirements	
Sources and limits	27.5 volts, d-c, +10% -20%. 115 volts ±10%, 380 to 420 cps. 115 volts ±10%, 300 to 1000 cps. (115-volt 380- to 420-cps source may be used for both 115-volt requirements.)

Table of Equipment Specifications (Sheet 1 of 9)
Figure 4

CHARACTERISTIC	SPECIFICATION
Receive only	
27.5 volts, d-c	0.280 amp, 7.7 watts, maximum.
115 volts, 380 to 420 cps	0.6 amp, 42 watts, maximum (includes 16 watts blower power).
115 volts, 300 to 1000 cps	0.850 amp, 88 watts, maximum.
Transmit/receive (search)	
27.5 volts, d-c	0.350 amp, 9.625 watts, maximum.
115 volts, 380 to 420 cps	0.6 amp, 42 watts, maximum (includes 16 watts blower power).
115 volts, 300 to 1000 cps	0.95 amp, 95 watts, maximum.
Transmit/receive (track)	
27.5 volts, d-c	0.310 amp, 8.525 watts, maximum plus flag current which does not exceed 0.5 amp, 13.75 watts.
115 volts, 380 to 420 cps	0.6 amp, 42 watts, maximum (includes 16 watts blower power).
115 volts, 300 to 1000 cps	0.860 amp, 89 watts, maximum.
Channeling	Same as receive only except 1.3 amp at 27.5 volts d-c is required.
R-f power output	The r-f peak power output is 1000 watts ±3 db into a 50-ohm load with the difference between the first and second transmitted pulse no greater than 1 db.
Load impedance	The impedance presented to the 860E-2 by the antenna and transmission line is a nominal 50 ohms, and the vswr shall not exceed 1.5:1 over the frequency range of 962 to 1213 mc.
Frequency range	
Transmit	1025 to 1150 mc with 1-mc channels.

Table of Equipment Specifications (Sheet 2 of 9)
Figure 4

CHARACTERISTIC	SPECIFICATION
Receive	
X channels	962 to 1024 mc and 1151 to 1213 mc with 1-mc channels.
Y channels	1025 to 1150 with 1-mc channels.
Number of channels	252.
Channeling time	10 seconds maximum.
Frequency stability	The transmitter, first injection and second injection signals are accurate to ±0.005%.
Interrogation pulse pair repetition rate	146 ±4 pulse pairs per second on search. 21 ±2 pulse pairs per second on track.
Interrogator pulse coding	Pulse spacing is 12 ±0.5 usec for normal operation (X channels) and 36 ±0.5 usec for split channel operation (Y channels).
Interrogation pulse characteristics	
Pulse rise time (10 to 90 percent voltage points)	Does not exceed 3 usec.
Pulse fall time (90 to 10 percent voltage points)	Does not exceed 3 usec.
Pulse duration (at the 50 percent voltage points)	3.5 ±0.5 usec.
Interrogation pulse spectrum	At least 90% of the transmitted energy is within ±0.25 mc of the selected channel frequency.
Search speed	More than 12 nautical miles per second.
Maximum range	0 to 192 nautical miles with 200-mile distance mechanism module, and 0 to 288 nautical miles with 300-mile distance mechanism module.
Suppression input pulse characteristics	
Amplitude	18 to 70 volts.

Table of Equipment Specifications (Sheet 3 of 9)
Figure 4

CHARACTERISTIC	SPECIFICATION
Polarity	Positive.
Rise time	20 volts/usec or greater.
Fall time	10 volts/usec or greater.
Input impedance	2000 ohms or greater.
Suppression output pulse characteristics	
Amplitude	20 to 35 volts.
Polarity	Positive.
Pulse rise time	20 volts/usec or greater.
Fall time	10 volts/usec or greater.
Pulse duration	47 ±3 usec.
Synchronization	18 volts amplitude 0.8 to 5.0 usec before the 10 percent level of the first transmitted pulse.
Distance accuracy	Over the range of +5°C to +45°C: (1) ±0.2 nautical mile from 0 to 192 nautical miles at 1000 knots with signal levels between -20 dbm and -80 dbm. (2) ±0.3 nautical mile from 192 to 288 nautical miles at 1000 knots with signal levels between -20 dbm and -80 dbm. (3) ±0.1 nautical mile from 0 to 5 nautical miles at 200 knots with signal levels between -20 dbm and -60 dbm.
Receiver sensitivity	With 70% reply efficiency and a standard TACAN test signal, the level required for 4 out of 5 lock-on's is not less than -86 dbm. The signal level required to produce minimum readable identification is no greater than the distance lock-on level.

Table of Equipment Specifications (Sheet 4 of 9)
Figure 4

CHARACTERISTIC	SPECIFICATION
Decoder selectivity	Signals are rejected with pulse spacings less than 8 usec or greater than 16 usec in the case of X channels and less than 26 usec or more than 34 usec in the case of Y channels for levels up to -48 dbm.
Cochannel performance	When two or more ground beacon signals on the same channel are received, and if one signal is 8 db or more larger in amplitude than the next stronger signal, the distance displayed is that of the stronger signal, and the aural identification identifies the stronger signal in an unambiguous manner. Further, when the difference in level between two such cochannel signals is such that lock-on to either signal may be obtained, the aural identification gives positive indication of this hazardous condition by garbling or by presenting both identifications. These conditions are met at signal levels up to -48 dbm for the stronger signal.
Lock-on and track characteristics	The 860E-2 DME locks on and tracks a target moving at speeds up to 2000 knots inbound or outbound. The 860E-2 tracks smoothly, and the flag remains out of view during aural identification.
Prememory	The prememory time shall be no more than two seconds.
Memory	(1) The memory time is no greater than 13 seconds except on ILS channels not overridden where it is no greater than 6 seconds. (2) Velocity or static type memory can be provided with proper internal jumper connections. (3) Memory is canceled following channeling or standby.
Aural identification	(1) The receiver gain is capable of being set such that a -86-dbm signal in accordance with section 3.7 of MIL-STD-291A produces at least 75 milliwatts of identification tone into a resistive load of 200 to 500 ohms. The noise average (Cont)

Table of Equipment Specifications (Sheet 5 of 9)
Figure 4

CHARACTERISTIC	SPECIFICATION
Aural identification (Cont)	(Cont) power output is 30 db below the level of the identification tone when the aural identification pulses are replaced with squitter pulses. An audio gain control is provided within the DME which allows adjustment of the output for any value from 0 to 75 milliwatts. (2) With the conditions of preceding paragraph (1), but with the equalizing pulses removed, the DME produces at least 15 milliwatts of identification tone into a resistive load of 200 to 500 ohms.
Cooling air	Cooling air must be provided in one of two ways: (1) By a blower mounted in the 860E-2 or, (2) By ARINC cooling at a recommended flow rate of 45 pounds per hour (absolute minimum flow rate of 29 pounds per hour) with cooling air temperature not to exceed 80°F in accordance with ARINC Specification No. 404.
Receiver selectivity	(1) The level of input signal required to produce a successful end of search four out of five search cycles does not vary more than 6 db for input signal frequencies in the range of ±200 kc from the assigned channel frequency under standard conditions. (2) When a TACAN signal having a center frequency 800 kc or more removed from the center frequency of the selected channel, and a signal level of -30 dbm is applied to the antenna terminal with no on-channel signal present, there is no aural identification or distance lock-on and the flag shall cover under standard conditions.
Range limit	The DME provides a short range function which allows the unit to search or track only out to a preset distance when operating on channels 17 X and Y to 56 X and Y inclusive. This distance is adjustable from 10 to 70 nautical miles with an accuracy of ±2 nautical miles. The 20 even-numbered X channels are designated ILS channels. The remaining 60 channels are designated TVOR channels.

Table of Equipment Specifications (Sheet 6 of 9)
Figure 4

CHARACTERISTIC	SPECIFICATION
Range limit override	(1) The DME provides the following range limit override options with proper internal jumper connections and the short range override control on wire P2-19: (a) TVOR overridable, ILS not overridable. (b) TVOR overridable, ILS overridable. (c) TVOR permanently overridden, ILS overridable. (d) TVOR permanently overridden, ILS permanently overridden. (2) When 300-mile capability is provided, the DME ranges to 288 nautical miles when overridden by means of the 200-nautical mile range override control wire on P1-30. When not overridden, the modulator is turned off at all ranges greater than a nominal 200 nautical miles. (3) Override is accomplished by grounding control wires P2-19 or P1-30 as appropriate. The circuitry is arranged so that override control of both P2-19 and P1-30 may be accomplished by one override switch on the pilot's control box.
Receiver output	
Polarity	Positive.
Impedance	Less than 500 ohms. (Until a bearing unit is implemented, an isolating diode, A3CR31, and two resistors, A3R56-A3R57, are provided. These components prevent the disabling of the agc circuit when an external suppression pulse is inadvertently connected to the RCVR OUT jack. The normal 500-ohm output can be provided by removing these components or can be obtained at test point A3J8.)
Amplitude	Not less than 4 volts peak at the crest of the modulated standard TACAN signal. The amplitude remains constant within ±20% over the input range of -83 dbm to -20 dbm.

Table of Equipment Specifications (Sheet 7 of 9)
Figure 4

CHARACTERISTIC	SPECIFICATION
Warning flag	(1) The DME provides a flag control switch that indicates a "not locked-on" condition. The switch is capable of controlling at least 0.5 ampere at 30 volts d-c. As part of the warning flag system, the DME provides 27.5 volts d-c +10%, -24% with at least 0.5 ampere capacity through an isolating diode to P1-9. (2) With the proper internal jumper connections, the DME causes the warning flag to appear: (a) Within 4 seconds after the DME goes into the memory mode of operation (fast flag). (b) When the DME completes the prescribed memory cycle without achieving lock-on (slow flag).
Self-test (optional)	The DME provides facilities for the incorporation of self-test circuitry. When activated by a ground potential on P1-21, the self-test circuit functions to break lock-on, cancel memory and slew the strobe inbound to slightly below 0 mile, reverse and lock on 0 mile. When the ground potential is removed from P1-21, the DME resumes normal operation. The self-test circuitry itself provides an accuracy of ±0.1 nautical mile.
Internal 27.5-volt d-c power supply (optional)	The DME provides facilities for the incorporation of a 27.5-volt d-c power supply which permits the DME to operate from the a-c input power leads only. The steady-state output voltage at P2-0 does not exceed 50 volts d-c.
Maximum input signal level	The application of an on-channel DME interrogation signal at the search interrogation rate, as specified herein, at any signal level up to -10 dbw into the DME antenna connector does not damage or adversely affect the reliability of the equipment.
Time delay	The 860E-2 incorporates a solid-state time-delay circuit capable of inhibiting the transmitter for 60 ±10 seconds after initial application of primary power.

Table of Equipment Specifications (Sheet 8 of 9)
Figure 4

CHARACTERISTIC	SPECIFICATION
Conducted interference	(1) Radio frequency energy in the frequency range from 90 kc to 350 mc from the DME under standard conditions does not exceed: (a) 200 microvolts between each cable terminal and ground when measured with a noise meter set to read average signal level. (b) 50 microwatts across a 50-ohm load on the antenna connector. (2) CW r-f energy in the frequency range from 960 to 1215 mc does not exceed -30 dbm with the exception that between 1015 and 1045 mc, the level does not exceed -47 dbm when measured across a resistive load of 50 ohms at the antenna connector.
Distance trip output (optional)	The DME provides facilities for the incorporation of a single make contact switch to provide a binary signal (ground) on P1-32 when the strobe is between -1.6 ±0.4 and 12.5 ±2.5 nautical miles. When the 12.5-nautical-mile trip switch is used for control of autopilot cutout over the cone of a VORTAC station, the following conditions must be satisfied: (1) When alarm flag is covering, the autopilot must be switched to heading. (2) When velocity memory is used, fast flag must be used.

Table of Equipment Specifications (Sheet 9 of 9)
Figure 4

3. EQUIPMENT DESCRIPTION.

A. Component Description.

(1) 860E-2 Distance Measuring Equipment.

The 860E-2 is housed in a 1/2 ATR case with front and rear extensions and weighs 37 or 37.2 pounds, depending on the model. (Models with 300-mile range weigh 37.2 pounds.) For exact dimensions of the extensions, see figure 409. Electrical connections to the 860E-2 are made at the rear of the unit through two type DPA-32-33P connectors which mate with the jacks on the required associated shockmount, and through two type BNC and one type C coaxial connectors at the front of the unit. The chassis assembly of

the 860E-2 forms the mounting base for 2 plug-in modules and five circuit boards. Each module and circuit board is constructed with a plug-in connector and a locating keying pin. The locating keying pins prevent incorrect placement of the subunits. Test points are provided for examination of significant voltages and waveforms. The transmit/receive channel which has been selected by the remote control unit is visible from the top rear of the unit; a course distance indication is visible from the front of the unit; and X or Y channel identification is visible on the left side of the unit.

A list of the fuses contained in the 860E-2 is given in figure 5. A list of the crystals used in the 860E-2 and their corresponding frequencies is given in figure 6.

The modules, boards, and subassemblies which make up the 860E-2 are listed in figure 7 and identified in figures 8 and 9.

SYMBOL	LOCATION	TYPE
F1	A1	1.5 amp, normal blow
F2	A1	1.0 amp, slow blow
F3	A1	0.5 amp, normal blow
F4	A1	1.5 amp, normal blow

Table of Fuses Used
Figure 5

SYMBOL	FREQUENCY (mc)
LOW FREQUENCY OSCILLATOR	
Y1	9.8629
Y2	9.9046
Y3	9.9463
Y4	9.9880
Y5	10.0296
Y6	10.0713
Y7	10.1130
Y8	10.1546
Y9	10.1963
Y10	10.2380
TIMING OSCILLATOR	
Y1	4045.6 cps

Table of Crystals Used (Sheet 1 of 2)
Figure 6

SYMBOL	FREQUENCY (mc)	SYMBOL	FREQUENCY (mc)
HIGH FREQUENCY OSCILLATOR		HIGH FREQUENCY OSCILLATOR (Cont)	
Y11	32.8037	Y18	35.7204
Y12	33.2204	Y19	36.1370
Y13	33.6370	Y20	36.5537
Y14	34.0537	Y21	36.9704
Y15	34.4704	Y22	37.3870
Y16	34.8870	Y23	37.8037
Y17	35.3037		

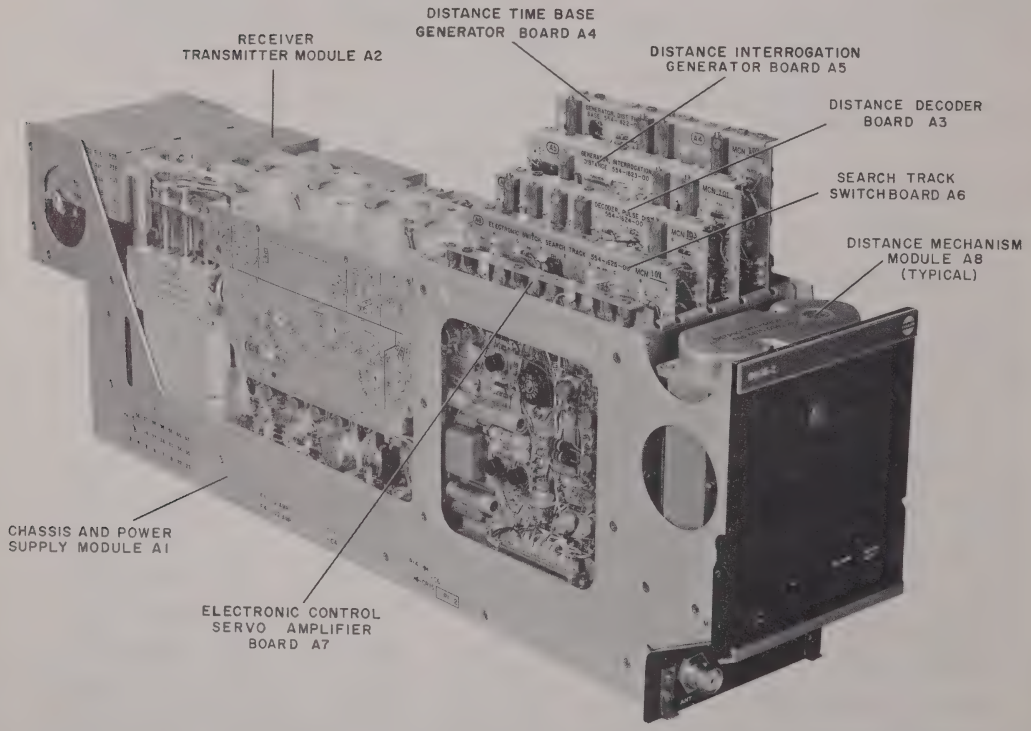
Table of Crystals Used (Sheet 2 of 2)
Figure 6

MODULE, BOARD, OR SUBASSEMBLY	DESIGNATION	COLLINS PART NUMBER
Chassis and Power Supply Module	A1	554-1621-00
Receiver Transmitter Module	A2	554-1627-00
Channel Selector Subassembly	A2A1	554-1632-00
Frequency Multiplier Amplifier Subassembly	A2A2	554-1630-00
Power Amplifier Subassembly	A2A3	554-1628-00
Modulator Subassembly	A2A4	554-1629-00
Preselector Subassembly	A2A5	554-1633-00
I-F Amplifier Subassembly	A2A6	554-1631-00
Distance Decoder Board	A3	554-1624-00
Distance Time Base Generator Board	A4	554-1622-00
Distance Interrogation Generator Board	A5	554-1623-00

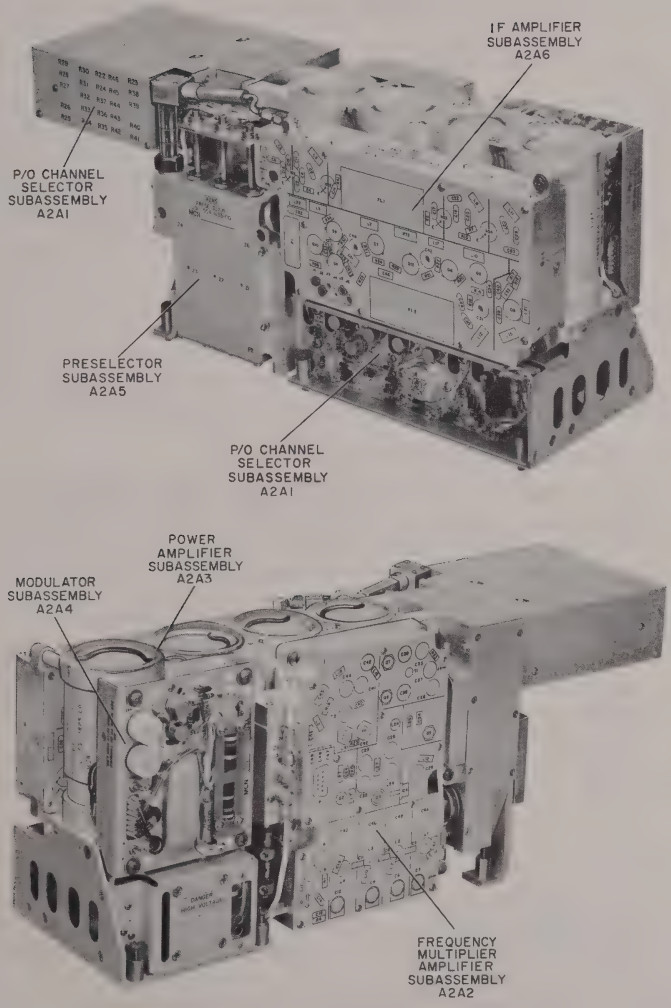
Table of Modules, Boards, and Subassemblies (Sheet 1 of 2)
Figure 7

MODULE, BOARD, OR SUBASSEMBLY	DESIGNATION	COLLINS PART NUMBER
Search Track Switch Board	A6	554-1625-00
Electronic Control-Servo Amplifier Board	A7	554-1626-011
Distance Mechanism Module (200-mile range)	A8	528-0455-004
Distance Mechanism Module (300-mile range)	A8	528-0470-005
Distance Mechanism Module (300-mile range)	A8	528-0470-006

Table of Modules, Boards, and Subassemblies (Sheet 2 of 2)
Figure 7


DISTANCE TIME BASE GENERATOR BOARD A4
RECEIVER TRANSMITTER MODULE A2
DISTANCE INTERROGATION GENERATOR BOARD A5
DISTANCE DECODER BOARD A3
SEARCH TRACK SWITCHBOARD A6
DISTANCE MECHANISM MODULE A8 (TYPICAL)
CHASSIS AND POWER SUPPLY MODULE A1
ELECTRONIC CONTROL SERVO AMPLIFIER BOARD A7

860E-2 Distance Measuring Equipment, Module Identification
Figure 8


IF AMPLIFIER SUBASSEMBLY A2A6
P/O CHANNEL SELECTOR SUBASSEMBLY A2A1
PRESELECTOR SUBASSEMBLY A2A5
P/O CHANNEL SELECTOR SUBASSEMBLY A2A1
POWER AMPLIFIER SUBASSEMBLY A2A3
MODULATOR SUBASSEMBLY A2A4
FREQUENCY MULTIPLIER AMPLIFIER SUBASSEMBLY A2A2

Receiver Transmitter Module, Subassembly Identification
Figure 9

Figure 10 deleted

(a) Chassis and Power Supply Module A1.

The chassis and power supply provides mounting facilities and interconnecting wiring for the plug-in modules and boards and the required connectors to couple the 860E-2 to associated equipment. The power supplies to convert 115 volts a-c to the required d-c and a-c outputs are located in A1. The blower and optional elapsed time indicator are also located in the chassis and power supply along with the optional primary power relay. A time-delay circuit is located in module A1 to delay the application of plate pulse power until the cavity tubes are heated.

Figure 11 deleted

(b) Receiver Transmitter Module A2.

1. Channel Selector Subassembly A2A1.

The channel selector subassembly contains the resistance bridge-Autopositioner* that allows remote selection of the desired transmit/receive channel. The crystal-controlled high- and low-frequency oscillators and mixer are also contained in the channel selector subassembly.

2. Frequency Multiplier Amplifier Subassembly A2A2.

The frequency multiplier amplifier subassembly contains the Autopositioner-tuned, 45-mc, band-pass filter that is used to filter the signal from the mixer located in A2A1. Also contained in A2A2 is a one-stage 45-mc amplifier, three X2 multipliers, a three-stage amplifier, and an X3 multiplier. These amplifiers and multipliers increase the input signal in frequency and amplitude. The CW output signal drives the power amplifier and injects the first mixer in the receiver.

3. Power Amplifier Subassembly A2A3.

The power amplifier subassembly contains four plate-pulsed cavity amplifiers to increase the power of the signal from A2A2. The amplifiers are tuned automatically by the Autopositioner mechanism when a channel is selected.

4. Modulator Subassembly A2A4.

The modulator subassembly contains the circuitry to pulse modulate the cavity amplifiers in A2A3. The trigger pulses used to activate the modulator are generated in the distance interrogation generator.

*Registered in U.S. Patent Office

5. Preselector Subassembly A2A5.

The preselector subassembly contains a three-cavity preselector and a crystal mixer to mix the reply signal with the injection signal from A2A2. The three-cavity resonators are automatically tuned by the Autopositioner tuning mechanism when a channel is selected.

6. I-F Amplifier Subassembly A2A6.

The i-f amplifier subassembly contains a four-stage, agc-controlled, 63-mc amplifier to amplify the first i-f signal from A2A5. Also contained in A2A6 is a crystal-controlled, 63- to 10.7-mc converter; a two-stage second i-f amplifier with a 10.7-mc filter between stages; a signal detector; a video amplifier; and a deblocker amplifier.

(c) Distance Decoder Board A3.

The distance decoder board provides decoded distance, tone identification, and azimuth information from the composite TACAN signal. The distance information is applied to the distance measuring circuits. The tone identification is applied to pins P2-23 and P2-24. The azimuth information is applied to jack J11 and may be used to operate an optional external azimuth box. The agc voltage is also derived in distance decoder board A3.

(d) Distance Time Base Generator Board A4.

The distance time base generator board contains the 4045.6-cps crystal-controlled oscillator that is used to establish a time base for the distance measuring operation. Also contained in A4 is the phase shift circuitry to encode the interrogation pulses for both the X and Y channels, the resolver phase shift circuits, and the signal controlled search circuits.

(e) Distance Interrogation Generator Board A5.

The distance interrogation generator board contains the interrogation rate countdown circuit and the suppressor pulse generator. Also contained in A5 are the 200/300-mile sweep circuit, controlled by the range potentiometer located in the distance mechanism module; the selector gate generator; and the range gate countdown circuit.

(f) Search Track Switch Board A6.

The search track switch board contains the range gate generator and the ramp voltage generator. An error detector is also located in A6 to determine if the distance reply pulses are in the center of the range gate. The search track switch, the memory and prememory circuits, the interrogation prf switch and the circuitry to control the signal applied to the distance servo motor are also located in A6.

(g) Electronic Control-Servo Amplifier Board A7.

The electronic control-servo amplifier board contains the flag and memory logic circuits. The circuits in A7 also control the override function, turn off the modulator when required, and control the search limit. The self-test circuits and servo amplifiers are located in A7.

Figure 12 deleted

(h) 200-Mile Distance Mechanism Module A8 (528-0455-004).

The 200-mile distance mechanism module contains a resolver, a range potentiometer, and motor-rate generator. Two synchro transmitters, a hundreds switch, and two optional potentiometers are geared to the motor-rate generator. The synchro transmitters and hundreds switch supply distance information to the distance indicator, and the optional potentiometers provide distance information for operation of a navigation computer. An optional 12.5-mile trip switch is also contained in A8.

(i) 300-Mile Distance Mechanism Module A8 (528-0470-005).

The 300-mile distance mechanism module contains a resolver and a motor-rate generator. Geared to the motor-rate generator are three synchro transmitters, two range limit switches, a distance measuring potentiometer and two computer-potentiometers. The synchro transmitters supply distance information to the distance indicator. The computer-potentiometers provide distance information for operation of a navigation computer.

(j) 300-Mile Distance Mechanism Module A8 (528-0470-006).

The 300-mile distance mechanism module, status number 006, is the same as the 005 status except that the motor-rate generator is geared to a 12-mile trip switch as well as the 3 synchro transmitters, 2 range limit switches, distance measuring potentiometer and the two computer-potentiometers. Refer to paragraph 3.A.(1)(i) above.

(2) 349D-3B Shockmount.

The 349D-3B Shockmount, figure 14, provides a mounting base for the 860E-2. Electrical connections are made through two DPA-32-33S-3-A101 connectors which mate with rear connectors of the 860E-2.

Figure 13 deleted

349D-3B Shockmount
Figure 14

(3) 237Z-1 Antenna.

The 237Z-1 Antenna, figure 15, is a blade monopole antenna used with DME and transponder equipment. The 237Z-1 is intended for pulsed transmission and reception between 960 and 1215 mc. The 237Z-1 is made of molded glass fiber in which the radiating element is hermetically sealed and imbedded in foamed plastic to prevent vibration of the element. The 237Z-1 is mounted to the bottom of the aircraft fuselage by six no. 6 F.H. screws. The type HN connector of the 237Z-1 goes through a clearance hole drilled in the bottom of the fuselage.

237Z-1 Antenna
Figure 15

(4) 339D-1, 339D-3B, 339D-3C, and 339D-3D Distance Indicators.

The 339D-1, 339D-3B, 339D-3C, and 339D-3D Distance Indicators are general purpose indicators which operate from the output of either a DME or Doppler Navigation System. The 339D-1/3B/3C/3D conform to ARINC indicator specifications for these applications. When operating as a part of the DME system, the indicator will register the distance of the aircraft from a fixed VORTAC or TACAN station. Figure 15A lists the unique characteristics of the distance indicators mentioned above.

	SINGLE INDICATOR	DUAL INDICATOR	RED LIGHTING	WHITE LIGHTING	REAR MOUNTING	FRONT MOUNTING
339D-1	X		X		X	
339D-3B		X	X		X	
339D-3C		X	X		X	X
339D-3D		X		X	X	X

Distance Indicator Characteristics
Figure 15A

(5) Control Units.

Any control unit with resistive bridge tuning per ARINC Characteristic 521C is capable of controlling the 860E-2 DME. Control units recommended for use with the 860E-2 are Collins 313N-2D, 313N-3D, 313N-4D, and 614U-7/8. The 614U-7/8 and 313N-4D Control Units have 50-kc channel spacing and may be used to control other navigation receivers when controlling the 860E-2. The 313N-2D and 313N-3D Control Units are capable of controlling both navigation and communication equipment. The 313N-2D has 25-kc channel spacing for communication tuning and the 313N-3D has 50-kc channel spacin.g. Both control units have 50-kc channel spacing on the navigation tuning portion. The 313N-2D, 313N-3D, and 313N-4D have 2 x 5 switching and the 614U-7/8 has 11 wire (re-entrant) switching for control of navigation receivers.

NOTE: When the function control on the control unit used with the 860E-2 is in OFF position, a ground must be retained on the standby line. The ground prevents transmitter "on" operation in 860E-2 DME's that are not provided with a primary power control relay.

B. System Description.

(1) Distance Measuring Operation.

The distance measuring operation begins when the transmitter portion of the 860E-2 DME sends out a pair of interrogation pulses. These interrogation pulses are received by the selected TACAN or VORTAC ground station. The ground station, after a fixed time delay, transmits a pair of reply pulses. These reply pulses are received and detected in the receiver portion of the 860E-2 DME and applied to the computing circuits. The computing circuits measure the time interval between the transmission of interrogation pulses and the reception of reply pulses. The time interval, which is proportional to the slant distance between the aircraft and the ground station, is converted to distance information and displayed on the DME distance indicator.

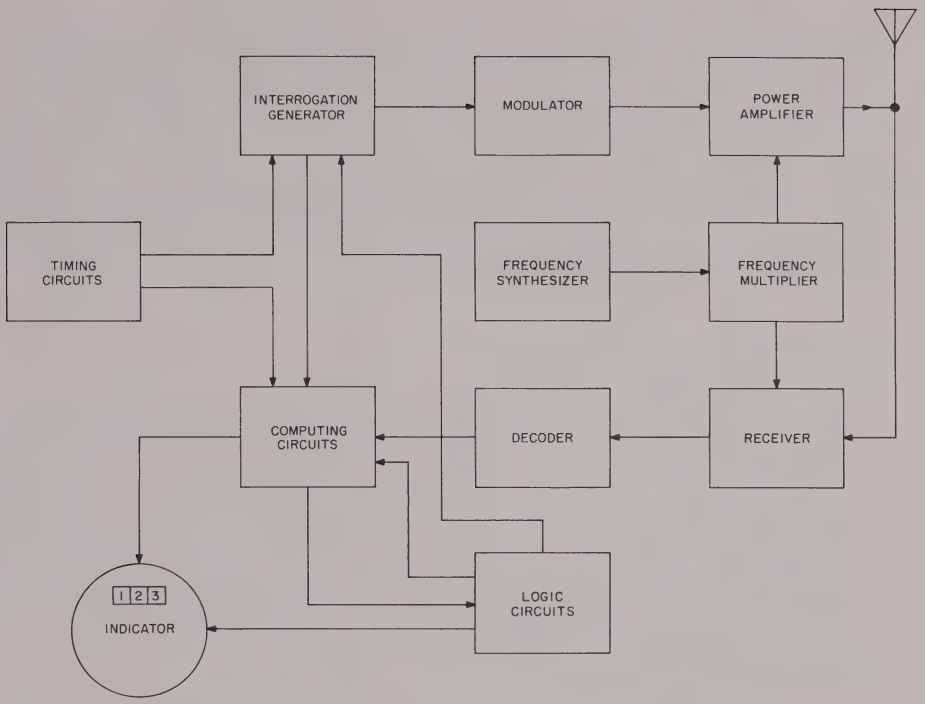
(2) Ground Stations.

(a) TACAN.

A TACAN ground station has the capabilities to reply to DME distance interrogation signals and also to transmit bearing information and identification signals. The bearing information consists of amplitude-modulated pulses and is used mainly by the military as a source of bearing data. The identification signals are transmitted at intervals of 35 seconds and consist of pulse pairs of pairs at a fixed repetition rate of 1350 pulse pairs per second.

(b) VORTAC.

A VORTAC station consists of a TACAN station as described above and a VOR transmitter to provide bearing information for aircraft equipped with VOR receivers. The VOR transmitter also transmits identification signals. The identification signals from the VOR transmitter and TACAN transmitter are synchronized so that one DME identification tone is received after every fourth VOR identification tone. The DME signal can be recognized by its higher tone.



860E-2 Distance Measuring Equipment, Block Diagram
Figure 16

(c) VOR/DME.

A VOR/DME station consists of a VOR station and the distance measuring portion of the TACAN station.

C. Block Diagram Theory of Operation. (See figure 16.)

The timing and logic circuits provide the interrogation generator with the required signals to produce coded pulses to modulate the transmit signal. The timing circuits provide the interrogation generator with the information required to code the pulses, and the logic circuits provide the interrogation generator with the information required to control the pulse interrogation rate. The interrogation pulses from the interrogation generator are applied to the modulator.

The frequency synthesizer generates a signal at 1/24 of the transmit frequency. This signal is frequency multiplied by 24 by the frequency multiplier and applied to the power amplifier. The power amplifier amplifies the signal from the frequency multiplier. The signal is pulse modulated by the action of the modulator before transmission.

The ground station reply signal is applied to the receiver where it is heterodyned with an injection signal the same frequency as the transmit signal. Since the ground station reply signal frequency is always 63 mc away from the transmit signal frequency, the first i-f is 63 mc. Further heterodyning is done in the receiver to produce a second i-f of 10.7 mc. The reply signal is then demodulated and the detected pulses are applied to the decoder. The decoder separates the distance replies from noise and other information transmitted by the ground station (see paragraph 3.B.(2)), and applies the distance reply pulses to the computing circuits. The computing circuits uses the information from the timing circuits and measures the time lapse between interrogation and reply pulses and converts this into distance information to drive the distance indicator. The logic circuits receive information from the computing circuits and control flag and memory operation.

D. Special Features.

(1) Reciprocating Search.

When the 860E-2 loses lock-on or is channeled to a new station and the indicator reads less than 50 miles, the reciprocating search circuits slew the strobe to slightly below zero before search begins. This saves the time formerly required to drive the strobe to zero by driving it past 200 or 300, depending on the equipment. The reciprocating search circuits also limit the search cycle of the 860E-2 on nonoverridden short range channels. The search cycle on short range channels is from 0 to the range limit with the modulator on, and back from the range limit to 0 with the modulator off. This replaces the old method of searching from 0 to the range limit with modulator on and from the range limit to 200 (or 300) to 0 with the modulator off.

(2) Signal Controlled Search.

A signal controlled search feature has been incorporated into the 860E-2 to prevent unnecessary search when the 860E-2 and VOR receiver are tuned to a VOR only station or when the selected ground station is out of range. When the signal detected by the receiving circuits of the 860E-2 is below a usable level, the signal controlled search circuits place the 860E-2 in standby. When the received signal increases to a usable level, full power is applied to the 860E-2 for normal operation. When the 860E-2 is channeled to a station with no DME and the indicator reads less than 50 miles, the strobe stops; when the distance indicator reads more than 50 miles, the strobe is driven to zero and stops.

COLLINS

MAINTENANCE
MANUAL

860E-2 Distance Measuring Equipment - Trouble Shooting

1. GENERAL.

To determine if the 860E-2 Distance Measuring Equipment is functioning properly, perform the tests outlined in the adjustment/test section of this manual.

860E-2 Distance Measuring Equipment - Servicing

. GENERAL.

The 860E-2 Distance Measuring Equipment does not require servicing other than the periodic tests outlined in the adjustment/test section of this manual.

860E-2 Distance Measuring Equipment - Removal/Installation

1. INITIAL INSTALLATION.

A. General.

The 860E-2 requires no adjustment during flight so it may be mounted in any convenient location that is heated and pressurized. The antenna transmission line should be as short as possible. The aircraft engine, ignition system, and generator should be bonded and shielded to prevent electrical interference.

B. Preinstallation Testing.

The 860E-2 was completely tested and aligned prior to shipping. The purpose of the following test is to determine if the equipment was damaged during shipment. Complete testing information on the 860E-2 is given in the 860E-2 Distance Measuring Equipment, Overhaul Manual, Collins part number 523-0755913.

(1) Test Equipment Required.

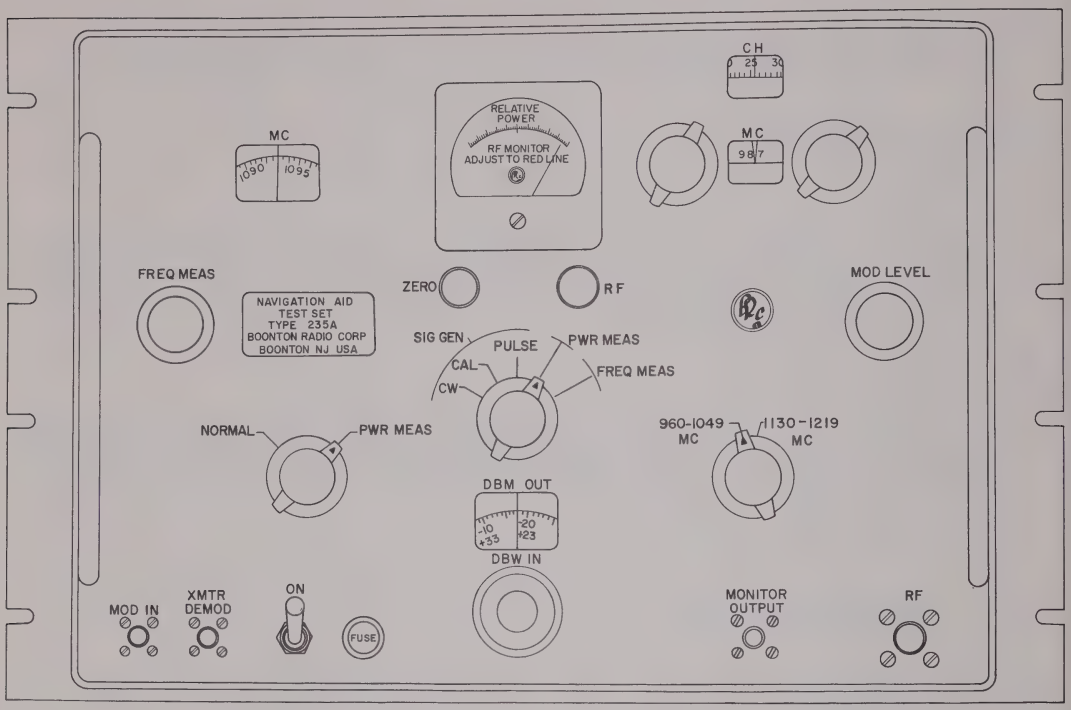
The test equipment listed in figure 401 or its equivalent is required to perform the preinstallation bench tests.

EQUIPMENT	DESCRIPTION
578D-1 DME Bench Test Set	Collins part number 522-1838-006
Navigation Aid Test Set	Boonton 235-A
Oscilloscope	Tektronix 535A or Tektronix 545A with dual trace plug-in head type C-A
D-c vtvm	Ballantine 300
Headset	200 to 5000 ohms

Table of Test Equipment Required
Figure 401

(a) Boonton Navigation Aid Test Set 235-A.

Boonton Navigation Aid Test Set 235-A, used with the 578D-1 DME Bench Test Set, provides calibrated DME test signals on 126 crystal-controlled channels. A front panel view of the 235-A is given in figure 402.



Boonton Navigation Aid Test Set 235-A, Front Panel View
Figure 402

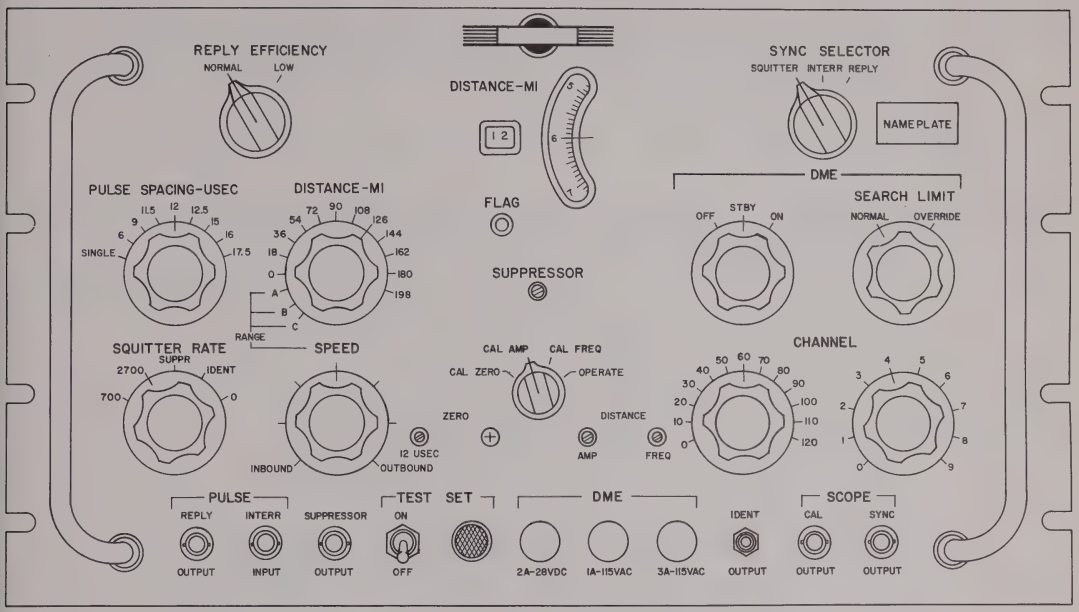
A 235-A accepts the r-f interrogation signal from the 860E-2 and, after detection, passes the resulting pulse signal through a front panel connector to the 578D-1 for decoding and reply generation. The pulse reply signal from the 578D-1 then is applied to another front panel connector on the 235-A and subsequently modulates the r-f signal generator to provide an r-f reply signal for the 860E-2.

Built-in meter circuitry permits calibration of the modulated output signal for receiver sensitivity measurements of the 860E-2. The same metering circuitry is used to measure the output power of the 860E-2.

Appropriate uhf detectors and associated front panel connectors are provided for external monitoring of signals generated by the 860E-2 and the 235-A.

(b) 578D-1 DME Bench Test Set.

The 578D-1 accepts and decodes the detected DME interrogations and provides accurately calibrated delays to simulate various distances. Squitter pulses are added, and after encoding, the resulting reply pulse signals are supplied to the 235-A which generates the r-f reply signal.



578D-1 DME Bench Test Set, Front Panel View
Figure 403

The 578D-1 also provides on the front panel all the controls necessary for operation of the DME equipment under test. A front panel view of 578D-1 is given in figure 403.

Tests of the DME distance accuracy are accomplished by front panel selection of time delays calibrated for specific fixed distances. The corresponding distance indication obtained from the DME set is presented on the front panel of the 578D-1 by means of a three-digit synchro-driven display which accurately simulates the distance indicator normally used in the DME installation. The display of the third digit is designed for a reading accuracy of better than ±0.1 mile.

Dynamic tracking performance of the DME set is tested by selecting a variable distance function which inserts a time delay varying at a selectable rate up to a simulated 3000 knots.

Various reply pulse spacings, centered on the normal value of 12 microseconds, are available for testing the DME decoder. Provision is made for the future addition of a second nominal pulse spacing.

Reply efficiencies of LOW and NORMAL are selectable on the front panel as are two representative squitter rates, identification tone operation, and a test position providing distance replies without squitter.

A coaxial output connection is provided on the front panel for synchronizing a cathode-ray oscillograph in trouble shooting the DME circuitry. Adjustments and oscilloscope connections for occasional calibration of the distance replies are also available on the front panel.

(2) Initial Adjustments.

(a) Interconnect the 860E-2 Distance Measuring Equipment, 578D-1 DME Bench Test Set, and Navigation Aid Test Set 235-A as shown in figure 404.

(b) Connect a 115/230-volt a-c, 50- to 420-cps supply to the 578D-1 and to the 235-A.

Connect a 115-volt a-c, 380- to 420-cps supply to the 578D-1.

Connect a 27.5-volt d-c supply to the 578D-1.

(c) Set the SEARCH LIMIT switch of the 578D-1 to NORMAL.

Set the PULSE SPACING-USEC switch of the 578D-1 to 12.

Set the SQUITTER RATE switch of the 578D-1 to 2700.

Set the DISTANCE-MI switch of the 578D-1 to 18.

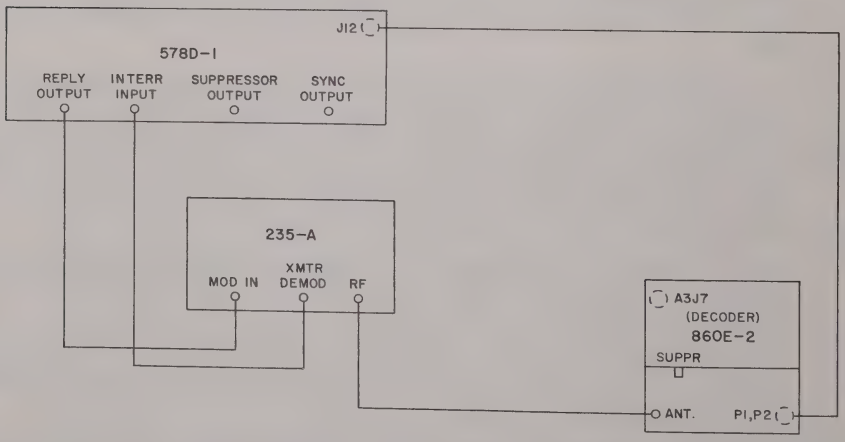
Set the REPLY EFFICIENCY switch of the 578D-1 to NORMAL.

Set the SYNC SELECTOR switch of the 578D-1 to SQUITTER.

Move the TEST SET switch of the 578D-1 to ON.

Move the power switch of the 235-A to ON.

Set the OFF/STBY/ON switch of the 578D-1 to STBY.



Test Setup No. 1
Figure 404

(d) Allow the 235-A, 578D-1, and 860E-2 units to warm up for 15 minutes, and then turn the OFF/STBY/ON switch of the 578D-1 to ON.

(3) Channel Selection Test.

(a) Select various channels on the 578D-1 by means of the CHANNEL switches of the 578D-1.

(b) Check that the 860E-2 channels to the corresponding channel by observing the channel numbers through the two windows on the top rear of the 860E-2.

(4) Receiver Sensitivity Test.

(a) Set the CHANNEL switch of the 578D-1 to 1. Select channel 1 on the 235-A.

NOTE: A channel is selected on the 235-A by rotating the coarse and fine adjustment knobs until the proper channel shows in the CH window and the receive frequency for this channel shows in the MC window. The receive frequency associated with any channel is identified in the DME G to A column of figure 407.

(b) Set the function selector switch of the 235-A to CW. Set the RF control to a maximum counterclockwise position.

(c) Adjust the pointer of the meter on the 235-A to a zero position by rotating the ZERO adjust control.

(d) Adjust the RF control on the 235-A for a red line reading of the pointer of the meter on the 235-A.

(e) Set the function selector switch of the 235-A to CAL, and note the meter reading.

(f) Set the function selector switch of the 235-A to PULSE, and adjust the MOD LEVEL control to obtain the same meter reading as in step (e).

(g) Set the db control for a reading of -90 dbm on the DBM OUT/DBW IN indicator.

(h) Set the OFF/STBY/ON switch on the 578D-1 to STBY and then to ON. The 860E-2 should go into search and then lock on at 18.

(i) Repeat step (h) five times. The 860E-2 must lock on at 18 a minimum of four times out of five searches to indicate proper receiver sensitivity.

(5) Transmitter Power Test.

(a) Set the function selector switch of the 235-A to PWR MEAS. Leave the 578D-1 and 235-A set to channel 1. Note the relative power level on the meter of the 235-A.

(b) Set the NORMAL/PWR MEAS switch of the 235-A to PWR MEAS.

(c) Adjust the db control to obtain the same reading on the meter as in step (a). Note the DBW IN reading on the DBM OUT/DBW IN indicator. This reading should be not less than +30 dbw.

(d) Repeat the procedures presented in paragraphs (4) and (5) for channels 63 and 126. The results should be the same.

(6) Decoder Selectivity Test.

(a) Leave the 578D-1 and 235-A set to channel 126. Set the db control for a reading of -90 dbm on the DBM OUT/DBW IN indicator.

(b) Set the NORMAL/PWR MEAS switch of the 235-A to NORMAL and the function selector switch of the 235-A to PULSE.

(c) Set the PULSE SPACING-USEC switch of the 578D-1 to 11.5. The 860E-2 should lock on at 18.

(d) Repeat step (c) with the PULSE SPACING-USEC switch at 12.5. The 860E-2 should lock on at 8.

(e) Set the PULSE SPACING-USEC switch to 6. The 860E-2 should go into search after approximately 10 seconds and not lock on at 18.

(f) Repeat step (e) with the PULSE SPACING-USEC switch set to 16. The response should be the same as in step (e).

(7) Identification Test.

(a) Set the 578D-1 and 235-A to channel 126. Set the SQUITTER RATE switch of the 578D-1 to IDENT.

(b) Set the db control on the 235-A to a reading of -90 dbm on the DBM OUT/DBW IN indicator.

(c) Plug a headset into the IDENT OUTPUT jack on the front panel of the 578D-1.

(d) Switch the SQUITTER RATE switch back and forth between 0 and IDENT positions to key the identification. A definite tone should be audible in the headset.

(8) Distance Accuracy Test.

(a) 200-Mile Range Modules.

1. Set the 578D-1 and 235-A to channel 126. Set the PULSE SPACING-USEC switch of the 578D-1 to 12. Set the SQUITTER RATE switch to 2700 and db control to -70 dbm.

2. Set the DISTANCE-MI switch to 0, 18, and 36, and allow the 860E-2 to lock on. Take a distance reading, integrating out small angular variations in the units dial. The required accuracy is ±0.1 mile.

3. Repeat step 2 for settings of the DISTANCE-MI switch at 54, 72, 90, 108, 126, 144, 162, and 180. The required accuracy is ±0.15 mile.

(b) 300-Mile Range Modules.

1. Repeat step (a)1. above.

2. Set the DISTANCE-MI switch to 1, 21, 41, and 61, and allow the 860E-2 to lock on. Take a distance reading, integrating out small angular variations in the units dial. The required accuracy is ±0.1 mile.

3. Repeat step (b)2. for settings on the DISTANCE-MI switch at 81, 101, 121, 141, 161, 181, and 201 miles. The required accuracy is ±0.15 mile.

(9) Search Range Limit Test.

(a) Set the CHANNEL switches on the 578D-1 to 17, and select channel 17 on the 235-A.

(b) Make ZERO, RF, and MOD LEVEL adjustments on the 235-A as described in steps (4)(b) through (4)(f).

(c) Set the db control to a reading of -87 dbm on the DBM OUT/DBW IN indicator.

(d) Set the SEARCH LIMIT switch on the 578D-1 to NORMAL.

(e) Set the DISTANCE-MI switch on the 578D-1 to RANGE A. Set the SPEED switch to OUTBOUND. Allow the 860E-2 to lock on.

(f) Observe the distance reading at which the 860E-2 stops tracking and immediately initiates searching in only the short range interval. Unless the 860E-2 is a model with the TVOR channels permanently overridden, the tracking should stop at the range limit. The range limit is set at approximately 50 miles at the factory, but it can be adjusted for any distance between 10 and 70 miles. Complete adjustment procedures are given in the 860E-2 Distance Measuring Equipment, Overhaul Manual, Collins part number 523-0755913. In 860E-2 DME's with TVOR channels permanently overridden, the 860E-2 should lock on and track out to a maximum of RANGE A which is not less than 70 miles.

(g) Set the SEARCH LIMIT switch on the 578D-1 to OVERRIDE. The 860E-2 (all units) should now lock on and track out to the maximum range of RANGE A which is not less than 70 miles.

(h) Set the CHANNEL switches on the 578D-1 to 18 and select channel 18 in the 235-A. Repeat steps (b) through (g). With the SEARCH LIMIT switch in the NORMAL position, the 860E-2 should track to the range limit unless the 860E-2 is a model with the ILS channels always overridden. With the SEARCH LIMIT switch in the OVERRIDE position, the 860E-2 should lock on and track out to the maximum range of RANGE A unless the 860E-2 is a model with the ILS channels not overridable.

(i) Set the CHANNEL switches on the 578D-1 to 57 and select channel 57 on the 235-A. Repeat steps (b) through (g). The 860E-2 should lock on and track to the maximum range of RANGE A for both positions of the SEARCH LIMIT switch on all models of 860E-2.

(10) Suppression Test.

(a) Connect the 860E-2, the 578D-1 DME Bench Test Set, and Navigation Aid Test Set 235-A together as shown in figure 405.

(b) Set the SYNC SELECTOR of the 578D-1 to REPLY.

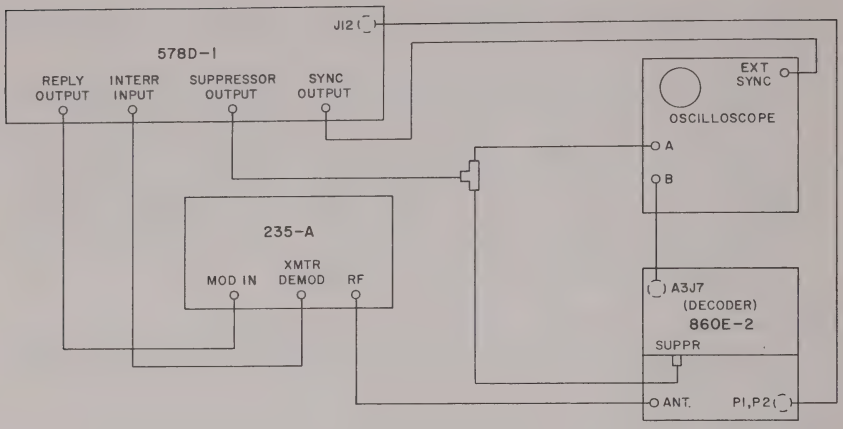
(c) Set the SQUITTER RATE switch of the 578D-1 to SUPPR.

(d) Set the oscilloscope for vertical inputs A and B, external synchronization, and a horizontal sweep rate of 10 usec/cm.

(e) Set the vertical gain of input A to 5 volts/cm and the vertical gain of input B for 5 volts/cm.

(f) Adjust the SUPPRESSOR level control of the 578D-1 to find the level necessary to suppress the video pulses at test point J7 of board A3 of the 860E-2. The level required should be not more than 18 volts.

(g) Disconnect the cable to SUPPRESSOR OUTPUT of the 578D-1 leaving the SUPPR connector of 860E-2 connected to input A of the oscilloscope. Place a 330-ohm load in place of the connection to the SUPPRESSOR OUTPUT of the 578D-1.



Test Setup No. 2
Figure 405

(h) Switch the oscilloscope to input A, internal synchronization, vertical gain of 10 volts/cm, and a horizontal sweep of 5 usec/cm.

(i) Measure the amplitude of the suppression pulse. This should be not less than 20 volts.

(j) Measure the pulse width of the suppression pulse at the 20-volt level. This should be 47 ±2.0 microseconds.

(11) Memory and Prememory.

(a) Select channel 57 on the 578D-1 and 235-A.

(b) Make ZERO, RF, and MOD LEVEL adjustments on the 235-A as in paragraphs (4)(b) through (4)(f).

(c) Set the db control on the 235-A for a reading of -87 dbm on the DBM OUT/DBW IN indicator.

(d) Set the DISTANCE-MI switch on the 578D-1 to 18 and allow the 860E-2 to lock on.

(e) After the 860E-2 has locked on, set the DISTANCE-MI switch to 0 and measure the time lapse between the setting of the DISTANCE-MI switch and the extinguishing of the FLAG lamp on the 578D-1. This time (flag time) should be not more than 3 seconds in 860E-2 DME's equipped with fast flag and 10 ±1.5 seconds in 860E-2 DME's equipped with slow flag.

(f) After the 860E-2 has locked on at 0, set the DISTANCE-MI switch to 18 and measure the time lapse between the setting of the DISTANCE-MI switch and when the 860E-2 begins to search. This time (memory time) should be 10 ±1.5 seconds for all 860E-2 DME's.

(g) After the 860E-2 has locked on at 18, set the DISTANCE-MI switch to 0. Measure the time interval from when the indicator stops at 0 and when the FLAG light on the 578D-1 comes on. This time (prememory time) should be not more than 1.5 seconds.

(h) Select channel 18 on the 578D-1 and 235-A. Set the SEARCH LIMIT switch to NORMAL.

(i) Repeat steps (b) through (g) with the SEARCH LIMIT switch in the NORMAL and OVERRIDE position. The performance should be as follows:

1. Flag time should be as follows:

a. Not more than 5.5 seconds with slow flag and ILS channel not overridden.

b. 10 ±1.5 seconds with slow flag, ILS channel overridden.

c. Not more than 3 seconds with fast flag and ILS channel either overridden or not overridden.

2. Memory time should be as follows:

a. Not more than 5.5 seconds with ILS channel not overridden.

b. 10 ±1.5 seconds with ILS channel overridden.

3. Prememory time should be 1.5 seconds.

NOTE: The ILS channel may be overridden with the SEARCH LIMIT switch or permanently overridden internally.

(12) AGC Performance Test.

(a) Leave the 578D-1 and 235-A set to channel 57, or select another channel if desired.

(b) Remove the 860E-2 dust cover. Connect a Ballantine 300 vtvm to test point J4 of i-f amplifier subassembly A2A6.

(c) Set the db control of the 235-A for a reading of -20 dbm on the DBM OUT/DBW IN indicator. The agc voltage, as measured at A2A6J4, should be about -10.5 volts d-c.

(d) Set the CHANNEL switch on the 578D-1 to 126; after about 10 seconds, return the CHANNEL switch to 57.

(e) At the instant the 860E-2 stops channeling, the agc voltage should increase to about -10.5 volts d-c. Replace the 860E-2 dust cover.

C. Mounting.

(1) 349D-3B Shockmount.

Secure the 349D-3B to the radio rack with 16 no. 10-32 screws, lock washers, and nuts. Connect the ground straps making sure a good ground exists. Note that the connectors of

the 349D-3B are held in place by screws at the rear of the mount so that cabling may be connected to the proper terminals with the connectors removed from the 349D-3B. Outline and mounting dimensions for the 860E-2 mounted on the 349D-3B Shockmount are given in figure 408. A clearance of at least one inch should be allowed at the top and sides of the 860E-2 to ensure proper operation of the 349D-3B and adequate ventilation.

(2) 860E-2.

The outline and mounting dimensions for the 860E-2 are given in figure 409.

(a) Loosen the locking mechanisms in the 349D-3B Shockmount by rotating the knurled nuts as far as possible in a counterclockwise direction.

(b) Place the 860E-2 in the 349D-3B and push to the rear, making sure that the plugs on the 860E-2 are inserted properly in the shockmount receptacles and that the extractor mechanism engages the 860E-2.

(c) Rotate the knurled nut of the extractor mechanism until the 860E-2 is fully engaged with the 349D-3B. Do not overtighten.

(d) Engage the holding clamps with the lugs on the front panel. Tighten the knurled nuts on the locking mechanisms until the 860E-2 is secured to the 349D-3B.

NOTE: When removing the 860E-2 from the 349D-3B Shockmount by using the extractor mechanism, be sure that the hold-down clamps are disengaged before rotating the extractor nut. The extractor mechanism is an aid in removing the 860E-2 not a means of holding the 860E-2 in place.

(3) 237Z-1 Antenna.

The outline and mounting dimensions for the 237Z-1 Antenna are given in figure 410. The 237Z-1 should be mounted on a horizontal portion of the aircraft in a location that will not deteriorate the antenna pattern. A line drawn between the forward and aft mounting holes should be parallel to the longitudinal axis of the aircraft. Position the 237Z-1 so that the connector is pointing to the rear and secure with the six screws supplied with the 237Z-1.

(4) Distance Indicator Installation.

The outline and mounting dimensions for the 339D-1 Distance Indicator are given in figure 411. The 399D-1 may be mounted in a standard 3-inch instrument cutout by using adapter plates. The outline and mounting dimensions for the 339D-3B are given in figure 412. The outline and mounting dimensions for the 339D-3C/3D are given in figure 413.

(5) Control Unit Installation.

Outline and mounting dimensions for the 614U-7/8, 313N-2D/3D and 313N-4D Control Units are given in figures 414, 415, and 415A. Secure the cable connector to the rear connector of the control unit. Fit the control unit in place and tighten the Dzus fasteners on the front panel. A momentary on switch to control the DME self-test must be provided if the 614U-7/8 Control Unit is used with an 860E-2 having self test.

EQUIPMENT	CONNECTOR	MATING CONNECTOR	
		TYPE	COLLINS PART NUMBER
860E-2	(2) Cannon type DPA-32-33P	Cannon type DPA-32-33S-3-A101	370-2072-00
	(2) BNC	UG-88C/U for RG-58/U cable	357-9292-00
	C	UG-573A/U for RG-8/U or RG-9/U cable UG-710A/U for right-angle connector	357-0008-00 357-9357-00
237Z-1	HN	UG-212A/U for right-angle connector UG-59A/U for straight connector	None 357-9039-00
313N-2D/3D	Bendix Scintilla PT02A-20-41P	Bendix Scintilla PT06E-20-41S	371-6107-00
	Bendix Scintilla PT02A-20-41PW	Bendix Scintilla PT06E-20-41SW	371-6108-00
313N-4D	Bendix Scintilla PT02A-20-41P	Bendix Scintilla PT06E-20-41S	371-6107-00
614U-7/8	Cannon DD-50-P	Cannon DD-50-S	371-0030-00
339D-1	Bendix PB02A-14-19P	Bendix PB06E-14-19S	371-1243-00
339D-3B/3C/3D	Bendix PT02E-22-32P	Bendix PT06E-22-32S	371-6351-00

Table of Mating Connectors
Figure 406

D. Cabling.

Point-to-point interconnections should be made in the aircraft according to the installation diagram, figure 416. The mating connectors required for the various units are listed in figure 406. In making the interconnections the following points should be observed.

(1) Cooling Requirements.

Cooling of the 860E-2 may be accomplished by the self-contained blower or an ARINC cooling installation. The blower operates when pin 31 of the bottom rear connector is connected to pin 28 of the bottom rear connector. This connection should be made in the radio junction box when the 860E-2 is installed in a radio rack without forced air cooling.

When the 860E-2 is cooled by forced air per ARINC Characteristic 404, 45 pounds of cooling air per hour at a temperature not to exceed 27°C (80°F) is recommended. The absolute minimum rate of flow is 29 pounds per hour.

CAUTION: DO NOT BLOCK AIR INLET AND OUTLET HOLES.

(2) 26-Volt Synchro Excitation.

The jumpers (TP1 to BP28 and TP2 to TP22) shown in figure 416 provide synchro excitation from the internal, 26-volt, a-c supply of the 860E-2. This internal supply is capable of providing excitation for up to two indicators. Synchro excitation may be provided by an external 26-volt, 380- to 420-cps source by connecting the cold lead to TP1 and the hot lead to TP2. If an external source is used, the jumpers (TP1 to BP28 and TP2 to TP22) must be removed.

(3) Primary Power Requirements.

The 860E-2 requires two 115-volt a-c supplies, and if the 860E-2 to be installed does not have the optimal 27.5-volt internal supply, a 27.5-volt d-c supply is also required. One 115-volt a-c source may be used if it conforms to the 380- to 420-cps requirement.

(4) Antenna Connection.

The 237Z-1 Antenna is connected to the 860E-2 through an RG8 or RG9 coaxial cable fitted with either a UG-573A/U plug or a UG-710A/U right-angle plug. The fitted plug mates with the type C antenna (ANT) jack on the 860E-2. Figure 417 shows the assembly of a UG-573A/U connector to RG-8/U coaxial cable.

(5) Suppression Pulse Connection.

The suppression pulse connection is used for test purposes only. A single BNC connector (SUPPR) on the 860E-2 provides for both input and output suppression pulses. The connector is color-coded blue by a color patch on the front panel. The mating connector required is a UG-88/U fitted to an RG-58/U cable. Instructions for assembly of a UG-88/U connector to RG-58/U coaxial cable are given in figure 418. The impedance on the suppressor output presented by external equipment should be not less than 300 ohms in parallel with not more than 1850 picofarads.

(6) Audio Output Connections.

It is recommended that the audio output from the rear connector (BP23 and BP24) of the 860E-2 terminate in a load of 200 to 500 ohms. Power output delivered to the load is adjustable from zero to maximum.

(7) Receiver Output Connection.

A single BNC connector (RCVR OUT) on the 860E-2 provides a decoded pulsed output for future use of the DME as a source of TACAN azimuth information. The pulse output characteristics conform to the specifications of ARINC Characteristic 521C. The mating connector required is a UG-88/U connector fitted to RG-58/U coaxial cable. Instructions for assembly of a UG-88/U connector to the RG-58/U coaxial cable are given in figure 418.

(8) Trip Outputs.

Trip outputs from 860E-2 DME's that are equipped with distance mechanism modules with trip switches are obtained at pins TP31 and TP32. Pin TP31 is reserved for a precision trip switch output that may be provided in the future. Pin TP32 is the 12.5-mile trip switch output and is at ground potential when the distance measured by the 860E-2 is between -1.6 and 12.5 nautical miles.

(9) 200-Mile Range Override.

This is applicable only in 860E-2 DME's equipped with the 200/300-mile distance mechanism module. Pin P1-30, when grounded, allows the 860E-2 to search to 300 miles. User must supply 200-mile override capability by grounding P1-30 when 300-mile capability is desired. Override control of both P2-19 (short range override) and P1-30 (200-mile override) may be accomplished by one override switch on the pilot's control box, if desired.

E. Postinstallation Testing.

Perform the tests outlined in the adjustment/test section of this manual.

2. REPLACEMENT PROCEDURES.

A. 860E-2 DME.

(1) Removal.

(a) Loosen the knurled retainer nuts on the front of the 349D-3B Shockmount until the hold-down clamps can be slipped off the lugs in the front of the 860E-2.

(b) Rotate the knurled extractor nut clockwise until the plugs on the 860E-2 are clear of the 349D-3B receptacles.

(c) Slide the 860E-2 out of the 349D-3B.

(2) Replacement.

(a) Place the 860E-2 on the 349D-3B Shockmount and push toward the rear, ensuring the plugs on the 860E-2 are inserted properly in the 349D-3B receptacles and that the extractor mechanism engages the 860E-2.

(b) Rotate the extractor nut on the 349D-3B until the 860E-2 is properly seated. Do not overtighten.

(c) Engage the holding clamps with the lugs on the front panel of the 860E-2. Tighten the knurled retainers until the 860E-2 is secure in the 349D-3B Shockmount.

(d) Safety-wire the two holding clamps.

B. 349D-3B Shockmount.

(1) Removal.

NOTE: It is recommended that the 349D-3B be removed from the aircraft only when required for repair.

(a) Remove the 16 bolts securing the 349D-3B to the airframe.

(b) Remove the eight bolts securing the connector plugs to the 349D-3B. Replace the bolts in the plugs so that they are not lost.

(c) Remove the 349D-3B from the aircraft.

(d) If the connector plugs are damaged and require replacement, carefully tag or otherwise identify each of the wires connected to the plug, then unsolder all wires and remove the defective plug.

(2) Replacement.

(a) Scrape the metal mounting surface under each of the vibration mounts to provide a good electrical contact for the grounding straps.

(b) Replace the connector plugs in the rear of the 349D-3B.

(c) Replace and secure the 349D-3B, ensuring the ground straps make good electrical contact with the airframe.

(d) If the connector plugs were unsoldered from the cable, resolder the plugs to the cable, ensuring the correct connections are made. After the connections have been completed, the wiring should be checked carefully to make certain that the correct connections have been made to the plugs.

C. 237Z-1 Antenna.

(1) Removal.

(a) Disconnect the coaxial cable from the 237Z-1.

(b) Remove the 237Z-1 by removing the six screws securing it.

(2) Replacement.

(a) Secure the 237Z-1 Antenna to the aircraft by using six number six screws.

(b) Connect the coaxial cable to the 237Z-1.

TACAN CHANNEL NUMBER	DME G to A (mc)	DME A to G (mc)	VHF	TACAN CHANNEL NUMBER	DME G to A (mc)	DME A to G (mc)	VHF
1X	962	1025	134.40	13X	974	1037	135.60
1Y	1088	1025	134.45	13Y	1100	1037	135.65
2X	963	1026	134.50	14X	975	1038	135.70
2Y	1089	1026	134.55	14Y	1101	1038	135.75
3X	964	1027	134.60	15X	976	1039	135.80
3Y	1090	1027	134.65	15Y	1102	1039	135.85
4X	965	1028	134.70	16X	977	1040	135.90
4Y	1091	1028	134.75	16Y	1103	1040	135.95
5X	966	1029	134.80	*17X	978	1041	108.00
5Y	1092	1029	134.85	*17Y	1104	1041	108.05
6X	967	1030	134.90	**18X	979	1042	108.10
6Y	1093	1030	134.95	*18Y	1105	1042	108.15
7X	968	1031	135.00	*19X	980	1043	108.20
7Y	1094	1031	135.05	*19Y	1106	1043	108.25
8X	969	1032	135.10	**20X	981	1044	108.30
8Y	1095	1032	135.15	*20Y	1107	1044	108.35
9X	970	1033	135.20	*21X	982	1045	108.40
9Y	1096	1033	135.25	*21Y	1108	1045	108.45
10X	971	1034	135.30	**22X	983	1046	108.50
10Y	1097	1034	135.35	*22Y	1109	1046	108.55
11X	972	1035	135.40	*23X	984	1047	108.60
11Y	1098	1035	135.45	*23Y	1110	1047	108.65
12X	973	1036	135.50	**24X	985	1048	108.70
12Y	1099	1036	135.55	*24Y	1111	1048	108.75

*TVOR channels
**ILS channels

Table of Channel Selection Frequencies (Sheet 1 of 5)
Figure 407

TACAN CHANNEL NUMBER	DME G to A (mc)	DME A to G (mc)	VHF	TACAN CHANNEL NUMBER	DME G to A (mc)	DME A to G (mc)	VHF
*25X	986	1049	108.80	*37X	998	1061	110.00
*25Y	1112	1049	108.85	*37Y	1124	1061	110.05
**26X	987	1050	108.90	**38X	999	1062	110.10
*26Y	1113	1050	108.95	*38Y	1125	1062	110.15
*27X	988	1051	109.00	*39X	1000	1063	110.20
*27Y	1114	1051	109.05	*39Y	1126	1063	110.25
**28X	989	1052	109.10	**40X	1001	1064	110.30
*28Y	1115	1052	109.15	*40Y	1127	1064	110.35
*29X	990	1053	109.20	*41X	1002	1065	110.40
*29Y	1116	1053	109.25	*41Y	1128	1065	110.45
**30X	991	1054	109.30	**42X	1003	1066	110.50
*30Y	1117	1054	109.35	*42Y	1129	1066	110.55
*31X	992	1055	109.40	*43X	1004	1067	110.60
*31Y	1118	1055	109.45	*43Y	1130	1067	110.65
**32X	993	1056	109.50	**44X	1005	1068	110.70
*32Y	1119	1056	109.55	*44Y	1131	1068	110.75
*33X	994	1057	109.60	*45X	1006	1069	110.80
*33Y	1120	1057	109.65	*45Y	1132	1069	110.85
**34X	995	1058	109.70	**46X	1007	1070	110.90
*34Y	1121	1058	109.75	*46Y	1133	1070	110.95
*35X	996	1059	109.80	*47X	1008	1071	111.00
*35Y	1122	1059	109.85	*47Y	1134	1071	111.05
**36X	997	1060	109.90	**48X	1009	1072	111.10
*36Y	1123	1060	109.95	*48Y	1135	1072	111.15

*TVOR channels
**ILS channels

Table of Channel Selection Frequencies (Sheet 2 of 5)
Figure 407

TACAN CHANNEL NUMBER	DME G to A (mc)	DME A to G (mc)	VHF	TACAN CHANNEL NUMBER	DME G to A (mc)	DME A to G (mc)	VHF
*49X	1010	1073	111.20	61X	1022	1085	133.40
*49Y	1136	1073	111.25	61Y	1148	1085	133.45
**50X	1011	1074	111.30	62X	1023	1086	133.50
*50Y	1137	1074	111.35	62Y	1149	1086	133.55
*51X	1012	1075	111.40	63X	1024	1087	133.60
*51Y	1138	1075	111.45	63Y	1150	1087	133.65
**52X	1013	1076	111.50	64X	1151	1088	133.70
*52Y	1139	1076	111.55	64Y	1025	1088	133.75
*53X	1014	1077	111.60	65X	1152	1089	133.80
*53Y	1140	1077	111.65	65Y	1026	1089	133.85
**54X	1015	1078	111.70	66X	1153	1090	133.90
*54Y	1141	1078	111.75	66Y	1027	1090	133.95
*55X	1016	1079	111.80	67X	1154	1091	134.00
*55Y	1142	1079	111.85	67Y	1028	1091	134.05
**56X	1017	1080	111.90	68X	1155	1092	134.10
*56Y	1143	1080	111.95	68Y	1029	1092	134.15
57X	1018	1081	112.00	69X	1056	1093	134.20
57Y	1144	1081	112.05	69Y	1030	1093	134.25
58X	1019	1082	112.10	70X	1157	1094	112.30
58Y	1145	1082	112.15	70Y	1031	1094	112.35
59X	1020	1083	112.20	71X	1158	1095	112.40
59Y	1146	1083	112.25	71Y	1032	1095	112.45
60X	1021	1084	133.30	72X	1159	1096	112.50
60Y	1147	1084	133.35	72Y	1033	1096	112.55

*TVOR channels
**ILS channels

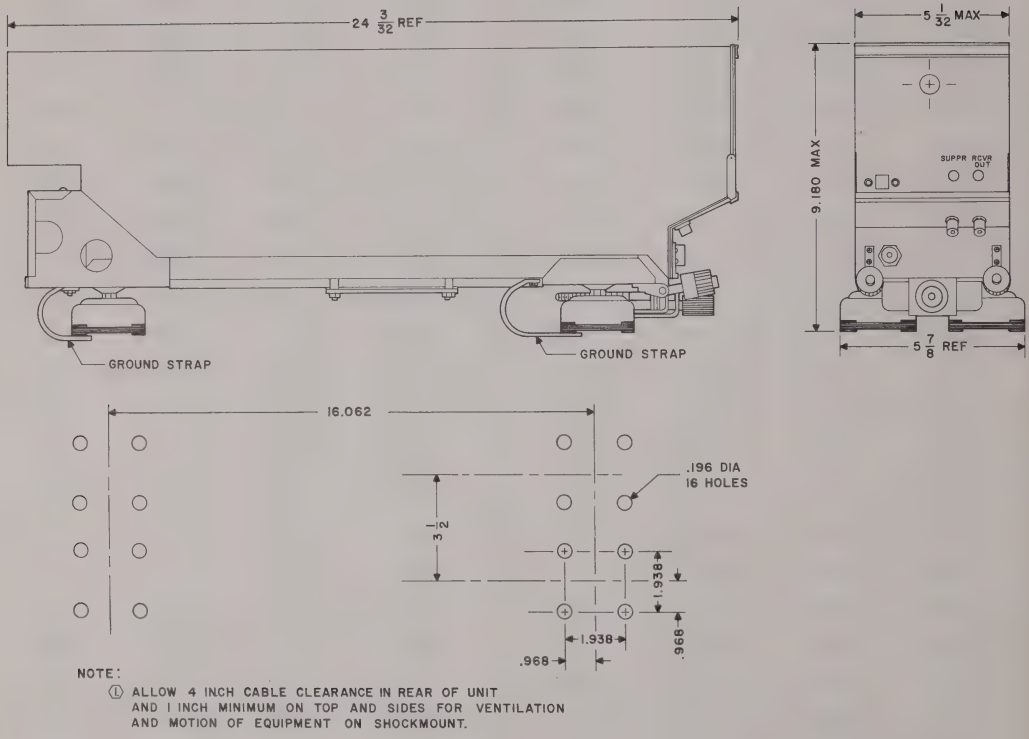
Table of Channel Selection Frequencies (Sheet 3 of 5)
Figure 407

TACAN CHANNEL NUMBER	DME G to A (mc)	DME A to G (mc)	VHF	TACAN CHANNEL NUMBER	DME G to A (mc)	DME A to G (mc)	VHF
73X	1160	1097	112.60	86Y	1047	1110	113.95
73Y	1134	1097	112.65	87X	1174	1111	114.00
74X	1161	1098	112.70	87Y	1048	1111	114.05
74Y	1035	1098	112.75	88X	1175	1112	114.10
75X	1162	1099	112.80	88Y	1049	1112	114.15
75Y	1036	1099	112.85	89X	1176	1113	114.20
76X	1163	1100	112.90	89Y	1050	1113	114.25
76Y	1037	1100	112.95	90X	1177	1114	114.30
77X	1164	1101	113.00	90Y	1051	1114	114.35
77Y	1038	1101	113.05	91X	1178	1115	114.40
78X	1165	1102	113.10	91Y	1052	1115	114.45
78Y	1039	1102	113.15	92X	1179	1116	114.50
79X	1166	1103	113.20	92Y	1053	1116	114.55
79Y	1040	1103	113.25	93X	1180	1117	114.60
80X	1167	1104	113.30	93Y	1154	1117	114.65
80Y	1041	1104	113.35	94X	1181	1118	114.70
81X	1168	1105	113.40	94Y	1155	1118	114.75
81Y	1042	1105	113.45	95X	1182	1119	114.80
82X	1169	1106	113.50	95Y	1156	1119	114.85
82Y	1043	1106	113.55	96X	1183	1120	114.90
83X	1170	1107	113.60	96Y	1057	1120	114.95
83Y	1044	1107	113.65	97X	1184	1121	115.00
84X	1171	1108	113.70	97Y	1058	1121	115.05
84Y	1045	1108	113.75	98X	1185	1122	115.10
85X	1172	1109	113.80	98Y	1059	1122	115.15
85Y	1046	1109	113.85	99X	1186	1123	115.20
86X	1173	1110	113.90	99Y	1060	1123	115.25

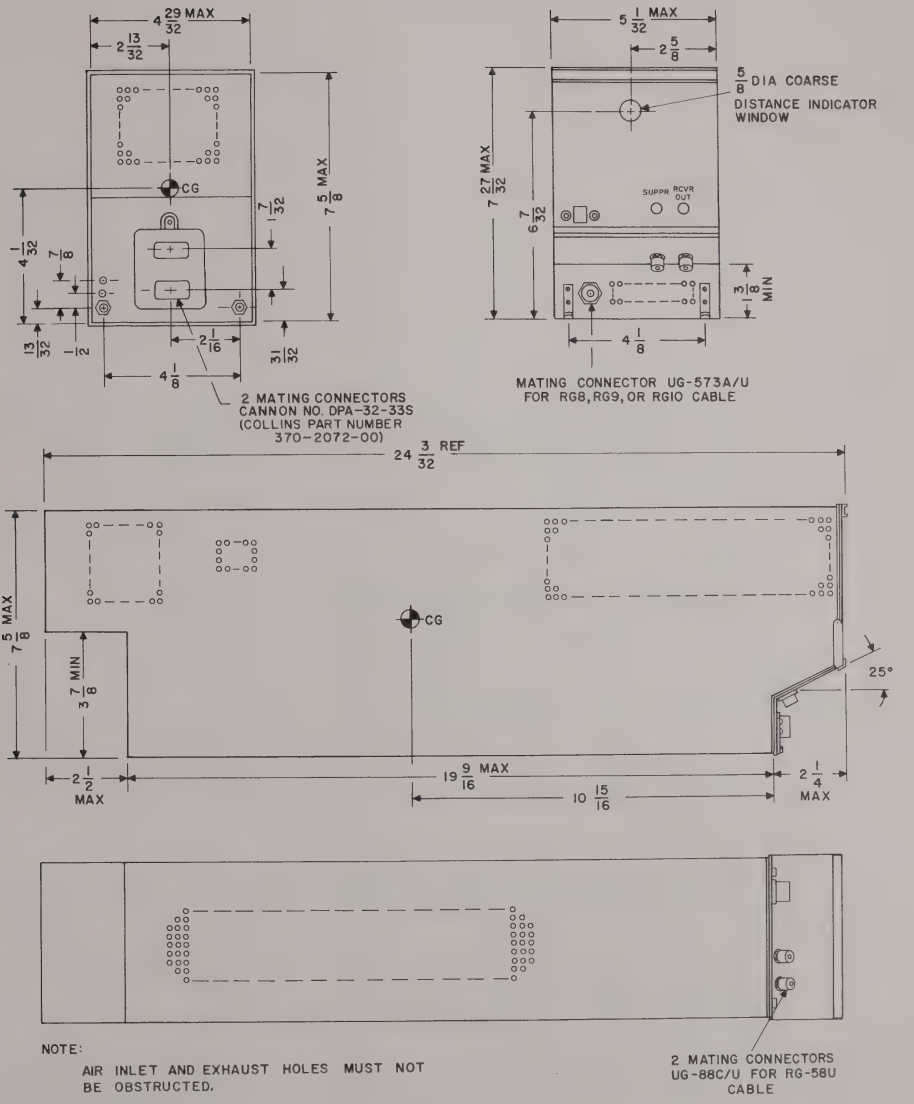
Table of Channel Selection Frequencies (Sheet 4 of 5)
Figure 407

TACAN CHANNEL NUMBER	DME G to A (mc)	DME A to G (mc)	VHF	TACAN CHANNEL NUMBER	DME G to A (mc)	DME A to G (mc)	VHF
100X	1187	1124	115.30	113Y	1074	1137	116.65
100Y	1061	1124	115.35	114X	1201	1138	116.70
101X	1188	1125	115.40	114Y	1075	1138	116.75
101Y	1062	1125	115.45	115X	1202	1139	116.80
102X	1189	1126	115.50	115Y	1076	1139	116.85
102Y	1063	1126	115.55	116X	1203	1140	116.90
103X	1190	1127	115.60	116Y	1077	1140	116.95
103Y	1064	1127	115.65	117X	1204	1141	117.00
104X	1191	1128	115.70	117Y	1078	1141	117.05
104Y	1065	1128	115.75	118X	1205	1142	117.10
105X	1192	1129	115.80	118Y	1079	1142	117.15
105Y	1066	1129	115.85	119X	1206	1143	117.20
106X	1193	1130	115.90	119Y	1080	1143	117.25
106Y	1067	1130	115.95	120X	1207	1144	117.30
107X	1194	1131	116.00	120Y	1081	1144	117.35
107Y	1068	1131	116.05	121X	1208	1145	117.40
108X	1195	1132	116.10	121Y	1082	1145	117.45
108Y	1069	1132	116.15	122X	1209	1146	117.50
109X	1196	1133	116.20	122Y	1083	1146	117.55
109Y	1070	1133	116.25	123X	1210	1147	117.60
110X	1197	1134	116.30	123Y	1084	1147	117.65
110Y	1071	1134	116.35	124X	1211	1148	117.70
111X	1198	1135	116.40	124Y	1085	1148	117.75
111Y	1072	1135	116.45	125X	1212	1149	117.80
112X	1199	1136	116.50	125Y	1086	1149	117.85
112Y	1073	1136	116.55	126X	1213	1150	117.90
113X	1200	1137	116.60	126Y	1087	1150	117.95

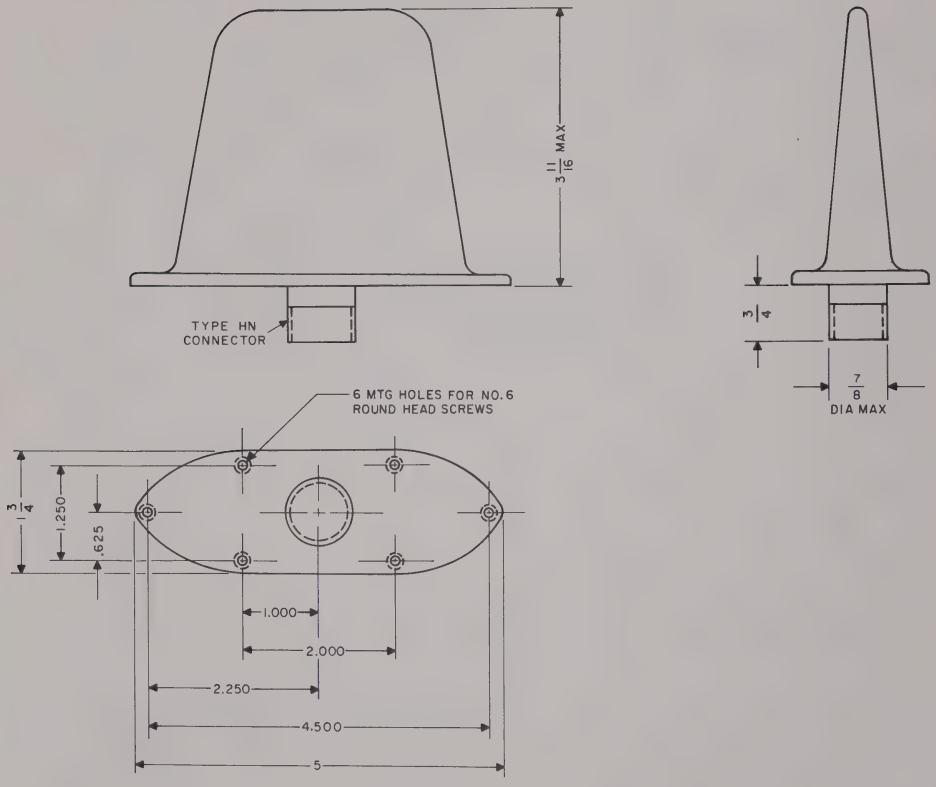
Table of Channel Selection Frequencies (Sheet 5 of 5)
Figure 407



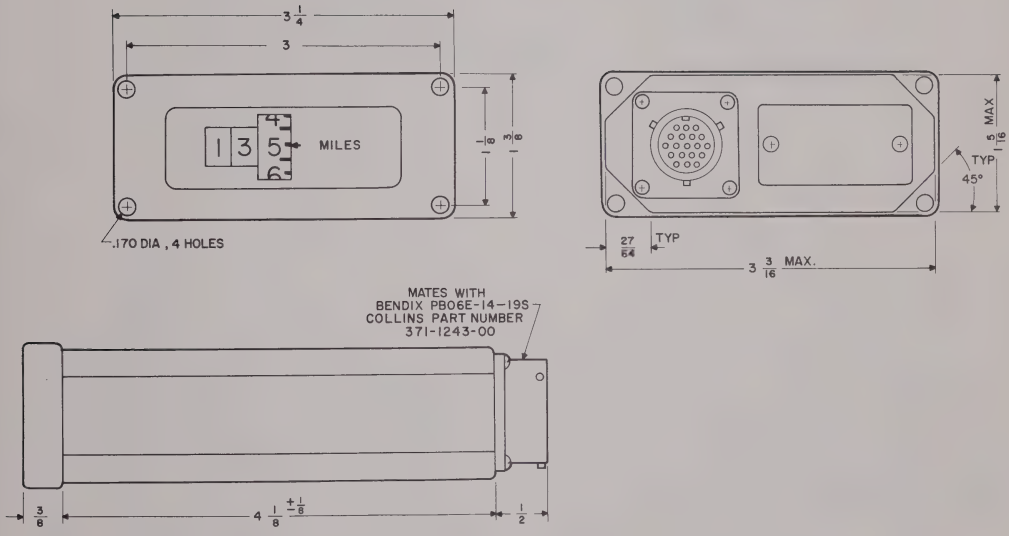
860E-2 Distance Measuring Equipment on 349D-3B Shockmount,
Outline and Mounting Dimensions
Figure 408



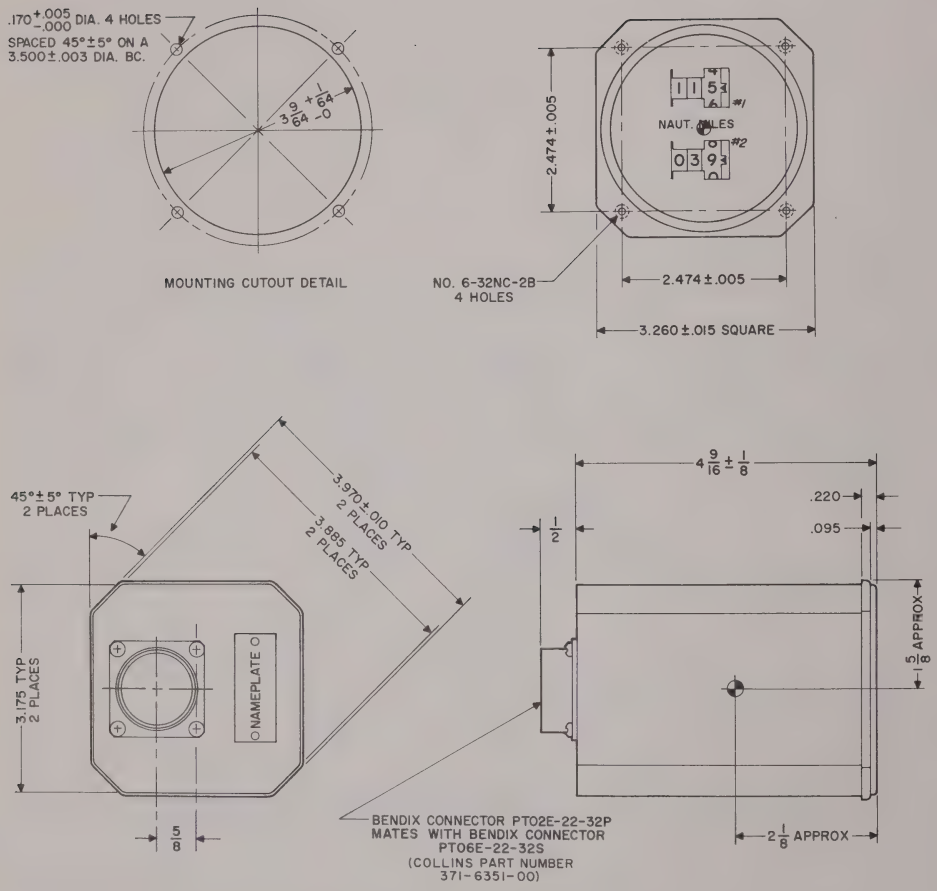
860E-2 Distance Measuring Equipment, Outline and Mounting Dimensions
Figure 409



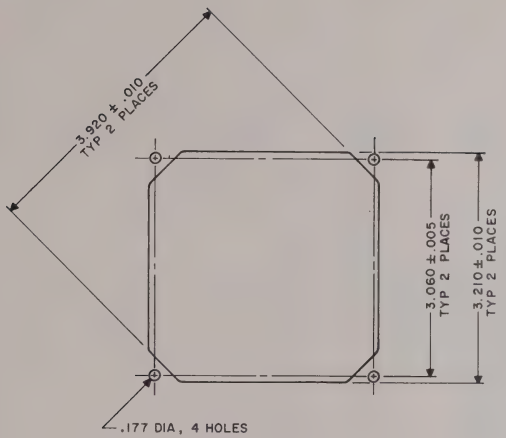
237Z-1 Antenna, Outline and Mounting Dimensions
Figure 410



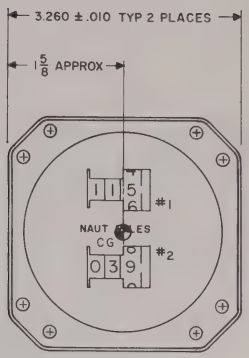
339D-1 Distance Indicator, Outline and Mounting Dimensions
Figure 411



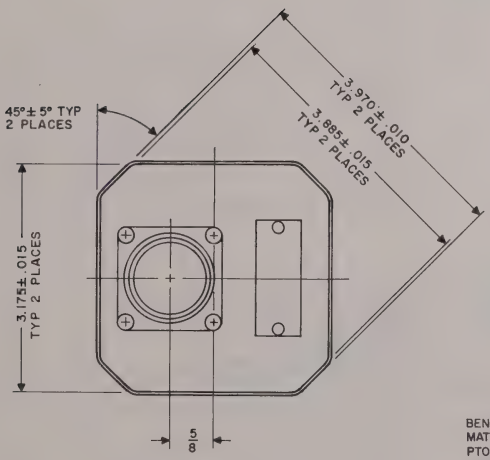
339D-3B Distance Indicator, Outline and Mounting Dimensions
Figure 412



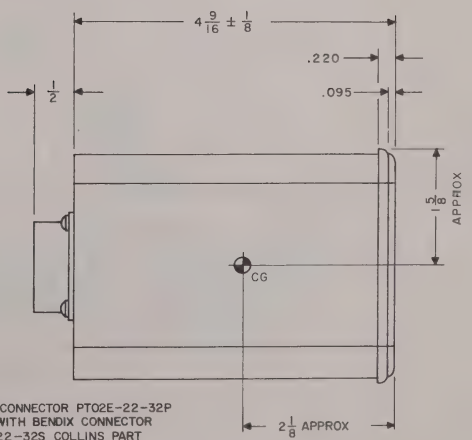
MOUNTING CUTOUT DETAIL



FRONT VIEW



REAR VIEW



BENDIX CONNECTOR PT02E-22-32P
MATES WITH BENDIX CONNECTOR
PT06E-22-32S COLLINS PART
NUMBER 371-6351-00

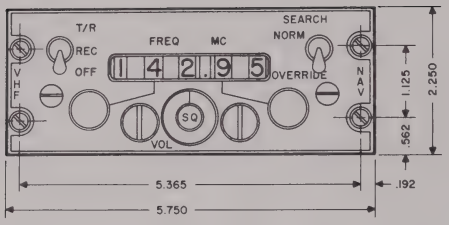
LEFT SIDE VIEW

NOTE:

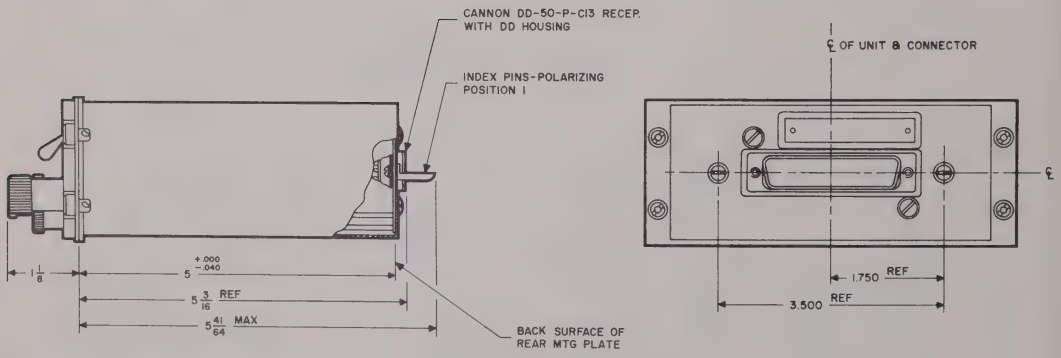
FOR FRONT MOUNTING USE CLAMP (COLLINS PN 139-3156-00) OR MOORING PLATE (COLLINS PN 553-6588-004) AND ADAPTER PLATE (COLLINS PN 553-6593-003) OR ADAPTER PLATE ONLY IF INSTRUMENT PANEL IS TAPPED FOR 6-32 MOUNTING SCREWS.

FOR REAR MOUNTING USE MOORING PLATE (COLLINS PN 553-6588-004) ONLY.

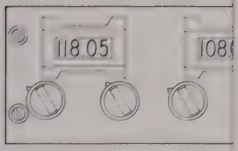
339D-3C/3D Distance Indicator, Outline and Mounting Dimensions
Figure 413

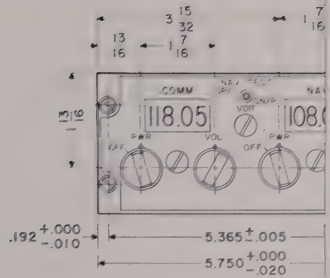


NOTE:
614U-7-BLACK PANEL & KNOBS.
614U-8-GREY (COLLINS NO. 220) PANEL & KNOBS.



614U-7/8 Control Unit, Outline and Mounting Dimensions
Figure 414

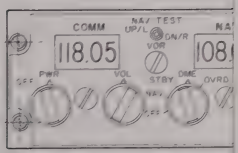




DIMENSIONS GIVEN THIS
ARE COMMON TO ALL U

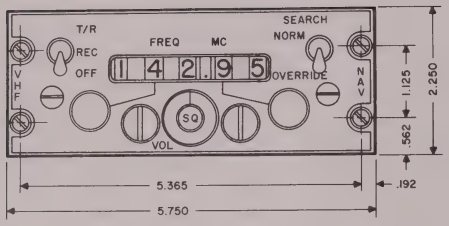
NOTES:

1. PART NO. 522-2448-005: THIS UNIT IS A COMM-NAV UNIT DESIGNED FOR SPECIAL INSTALLATIONS SUCH AS CUSTOMIZING. THE UNIT HAS A FREQUENCY RANGE AS FOLLOWS: COMM-118.00 TO 135.95MC. NAV-108.00 TO 117.95MC.
2. PART NO. 522-2448-015: THIS UNIT IS A COMM-NAV UNIT WITH FREQUENCY RANGE AS FOLLOWS: COMM-118.00 TO 135.95MC; NAV-108.00 TO 117.95MC.
3. PART NO. 522-2448-025: THIS UNIT IS A COMM-NAV UNIT WITH CONTROL FUNCTIONS TO REMOTELY CONTROL A DME RADIO SET PER ARINC CHARACTERISTIC 521B.
4. ALL UNITS SUPPLIED WITH 28 VDC RED LAMPS. FOR OTHER LIGHTING SEE TABLE BELOW
5. PART NO. 522-2448-035: THIS UNIT IS A COMM-NAV UNIT WITH FREQUENCY RANGE AS FOLLOWS: COMM-116.00 TO 135.95 MC. NAV-108.00 TO 117.95.
6. PART NO. 522-2448-045: THIS UNIT IS A COMM-NAV UNIT WITH FREQUENCY RANGE AS FOLLOWS: COMM-116.00 TO 149.95 MC. NAV-108.00 TO 117.95 MC.
7. PART NO. 522-2448-055: THIS UNIT IS A COMM-NAV UNIT WITH FREQUENCY RANGE AS FOLLOW: COMM-116.00 TO 149.95 MC. NAV-108.00 TO 117.95 PLUS 133.00 TO 135.95 FOR DME RADIO SET PER ARINC CHARACTERISTIC 521B.
8. MATING CONNECTOR PT06E-20-41SW, CPN 371-6108-00 MATES WITH PT02A-20-41PW. MATING CONNECTOR PT06E-20-41S, COLLINS PART NUMBER 371-6107-00 MATES WITH PT02A-20-41P.

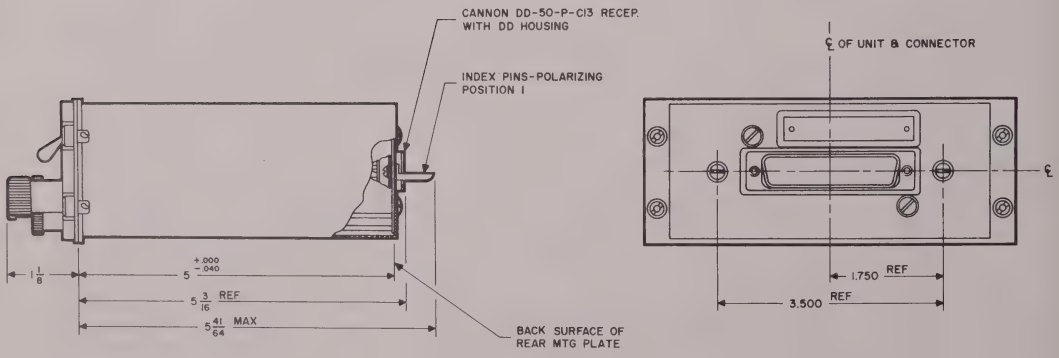


KITS AVAILABLE	
PART NO.	KIT
553-9290-00	KIT, LAMPS-5V, WHITE
553-9291-00	KIT, LAMPS-5V, RED
553-9292-00	KIT, LAMPS-28V, WHITE

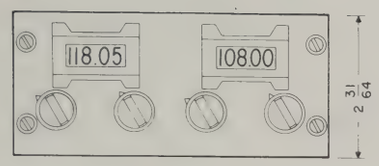
313N-2D/3D Control Unit, Outline
and Mounting Dimensions
Figure 415

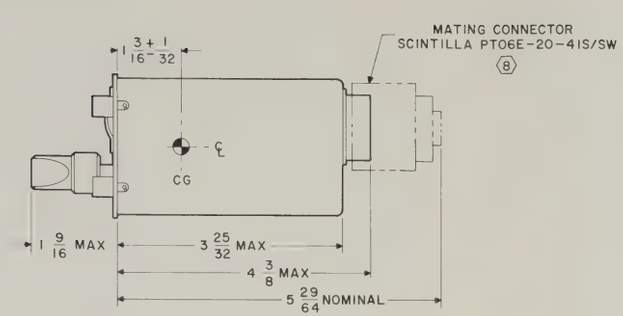


NOTE:
614U-7-BLACK PANEL & KNOBS.
614U-8-GREY (COLLINS NO. 220) PANEL & KNOBS.

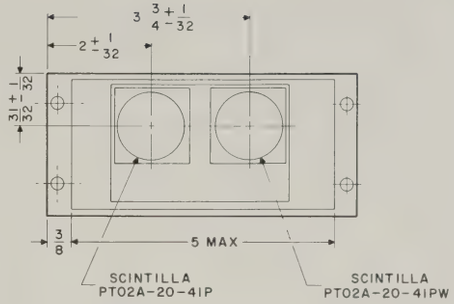


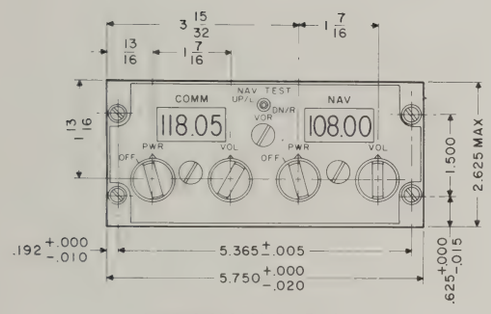
614U-7/8 Control Unit, Outline and Mounting Dimensions
Figure 414



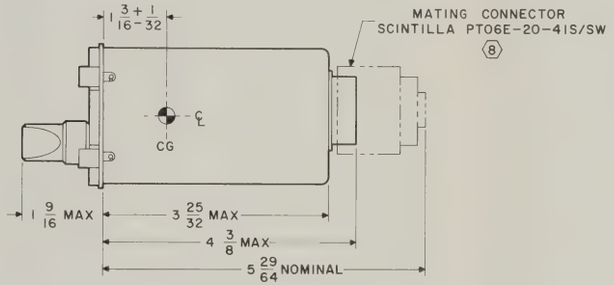


522-2448-005 ⟨1⟩ WEIGHT 2.0LB (WITH PLASTIC PANEL)

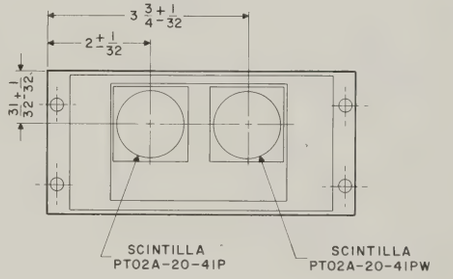


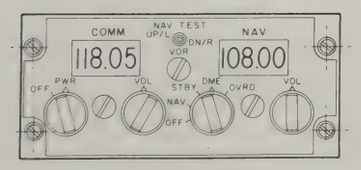


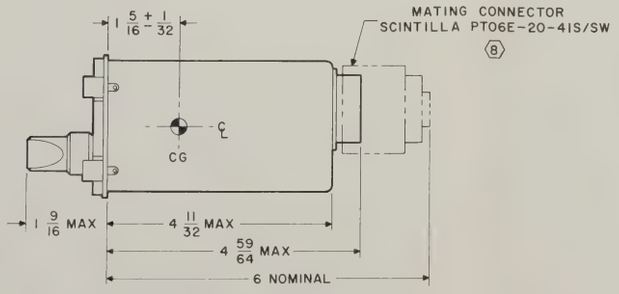
DIMENSIONS GIVEN THIS VIEW
ARE COMMON TO ALL UNITS



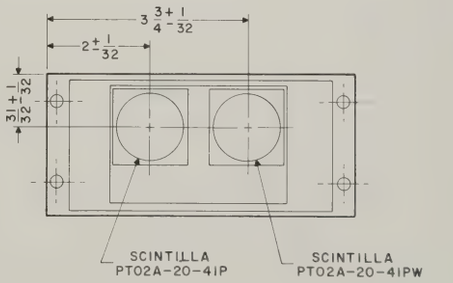
522-2448-015 ⟨2⟩ WEIGHT 2.0 LB
522-2448-035 ⟨5⟩ WEIGHT 2.0 LB
522-2448-045 ⟨6⟩ WEIGHT 2.0 LB







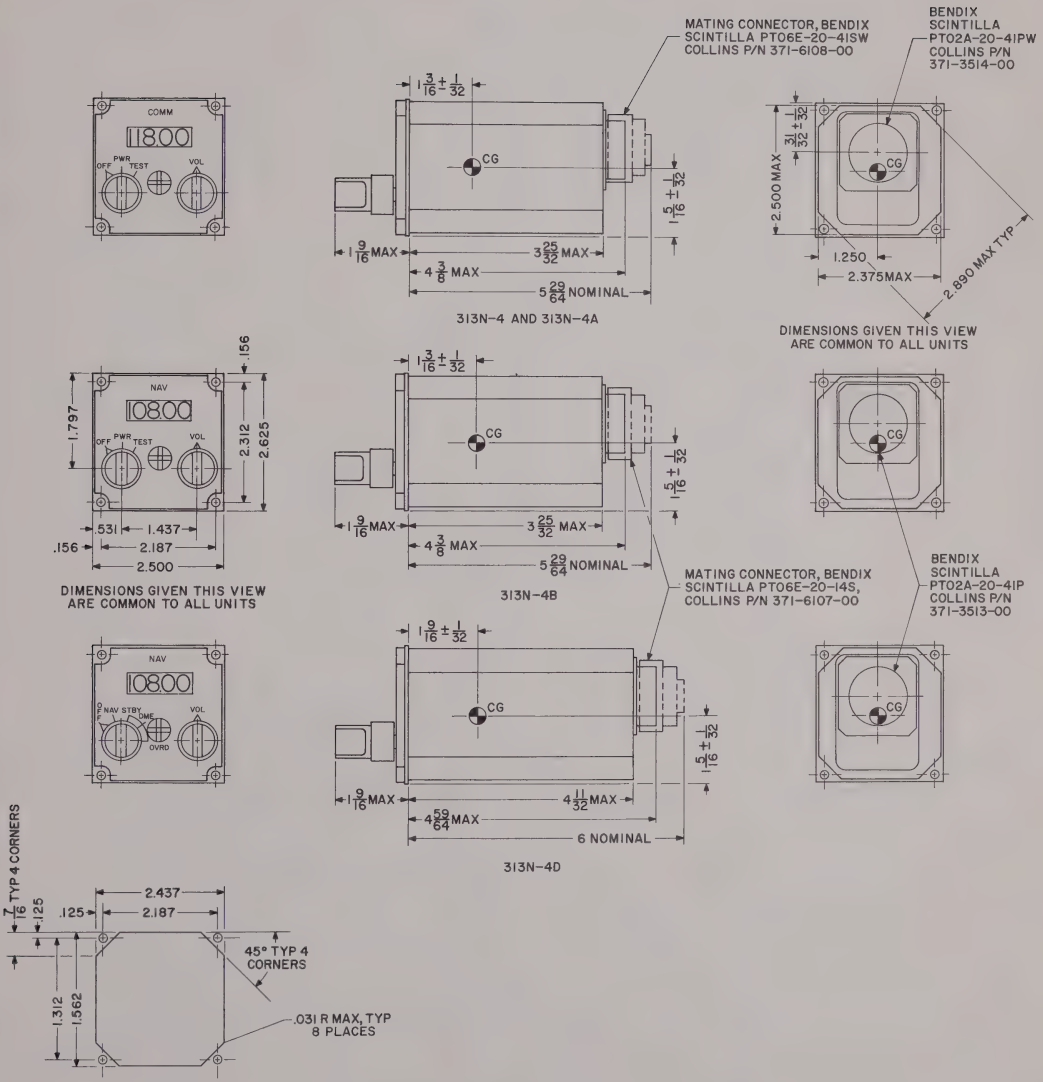
522-2448-025 ⟨3⟩ WEIGHT 2.2 LB
522-2448-055 ⟨7⟩ WEIGHT 2.25 LB



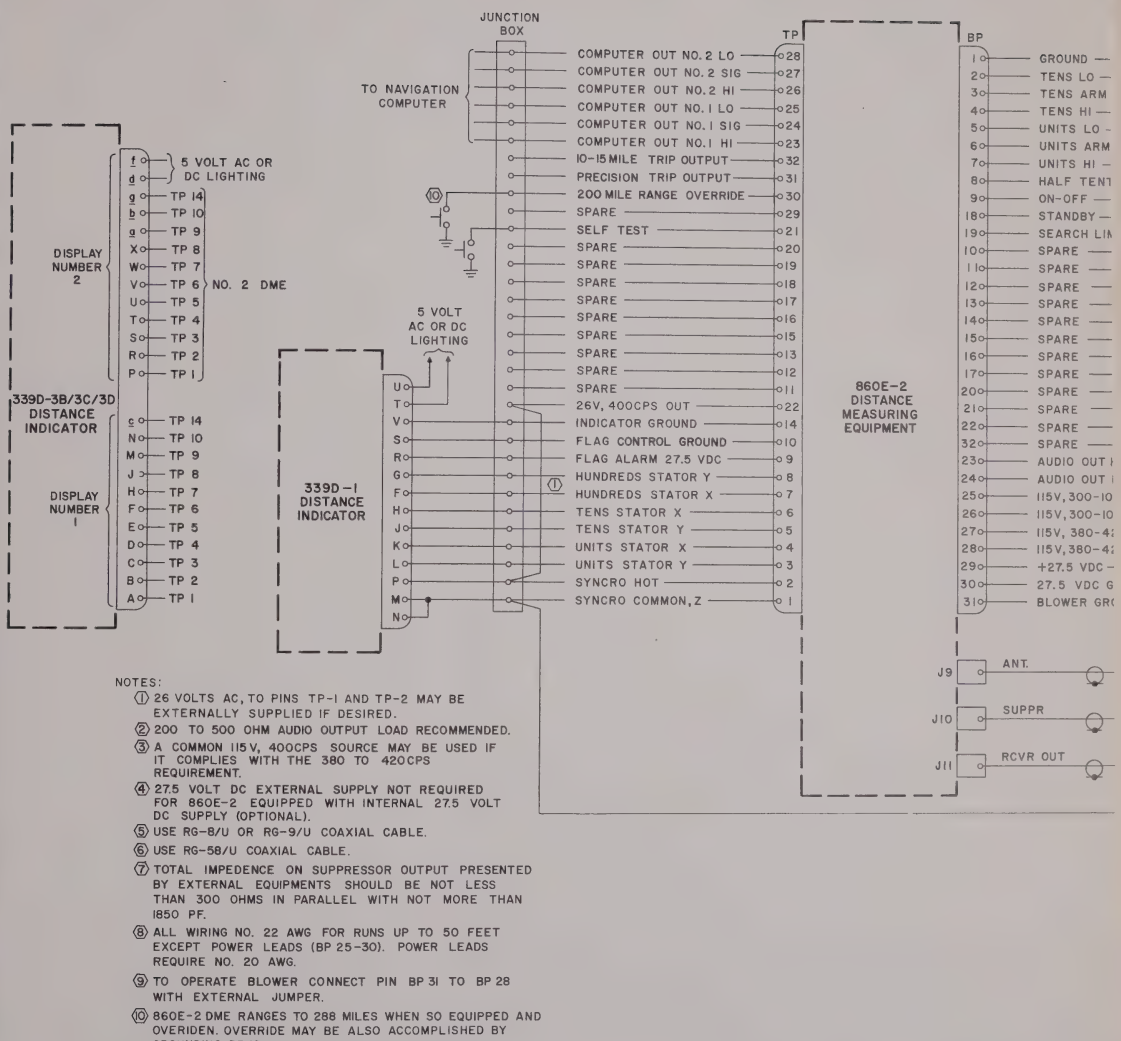
NOTES:
⟨1⟩ PART NO. 522-2448-005: THIS UNIT IS A COMM-NAV UNIT DESIGNED FOR SPECIAL INSTALLATIONS SUCH AS CUSTOMIZING. THE UNIT HAS A FREQUENCY RANGE AS FOLLOWS: COMM-118.00 TO 135.95MC. NAV-108.00 TO 117.95MC.
⟨2⟩ PART NO. 522-2448-015: THIS UNIT IS A COMM-NAV UNIT WITH FREQUENCY RANGE AS FOLLOWS: COMM-118.00 TO 135.95MC; NAV-108.00 TO 117.95MC.
⟨3⟩ PART NO. 522-2448-025: THIS UNIT IS A COMM-NAV UNIT WITH CONTROL FUNCTIONS TO REMOTELY CONTROL A DME RADIO SET PER ARINC CHARACTERISTIC 521B.
⟨4⟩ ALL UNITS SUPPLIED WITH 28 VDC RED LAMPS. FOR OTHER LIGHTING SEE TABLE BELOW
⟨5⟩ PART NO. 522-2448-035: THIS UNIT IS A COMM-NAV UNIT WITH FREQUENCY RANGE AS FOLLOWS: COMM-116.00 TO 135.95 MC. NAV-108.00 TO 117.95.
⟨6⟩ PART NO. 522-2448-045: THIS UNIT IS A COMM-NAV UNIT WITH FREQUENCY RANGE AS FOLLOWS: COMM-116.00 TO 149.95 MC. NAV-108.00 TO 117.95 MC.
⟨7⟩ PART NO. 522-2448-055: THIS UNIT IS A COMM-NAV UNIT WITH FREQUENCY RANGE AS FOLLOW: COMM-116.00 TO 149.95 MC. NAV-108.00 TO 117.95 PLUS 133.00 TO 135.95 FOR DME RADIO SET PER ARINC CHARACTERISTIC 521B.
⟨8⟩ MATING CONNECTOR PT06E-20-41SW, CPN 371-6108-00 MATES WITH PT02A-20-41PW. MATING CONNECTOR PT06E-20-41S, COLLINS PART NUMBER 371-6107-00 MATES WITH PT02A-20-41P.

KITS AVAILABLE	
PART NO.	KIT
553-9290-00	KIT, LAMPS-5V, WHITE
553-9291-00	KIT, LAMPS-5V, RED
553-9292-00	KIT, LAMPS-28V, WHITE

313N-2D/3D Control Unit, Outline
and Mounting Dimensions
Figure 415



313N-4/4A/4B/4D VHF Control, Outline and Mounting Dimensions
Figure 415A



NOTES:

① 26 VOLTS AC, TO PINS TP-1 AND TP-2 MAY BE EXTERNALLY SUPPLIED IF DESIRED.

② 200 TO 500 OHM AUDIO OUTPUT LOAD RECOMMENDED.

③ A COMMON 115 V, 400CPS SOURCE MAY BE USED IF IT COMPLIES WITH THE 380 TO 420CPS REQUIREMENT.

④ 27.5 VOLT DC EXTERNAL SUPPLY NOT REQUIRED FOR 860E-2 EQUIPPED WITH INTERNAL 27.5 VOLT DC SUPPLY (OPTIONAL).

⑤ USE RG-8/U OR RG-9/U COAXIAL CABLE.

⑥ USE RG-58/U COAXIAL CABLE.

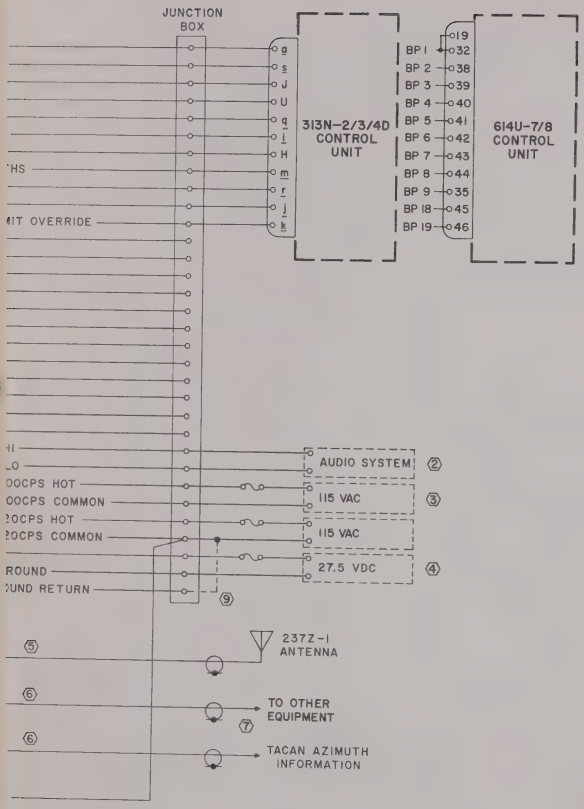
⑦ TOTAL IMPEDENCE ON SUPPRESSOR OUTPUT PRESENTED BY EXTERNAL EQUIPMENTS SHOULD BE NOT LESS THAN 300 OHMS IN PARALLEL WITH NOT MORE THAN 1850 PF.

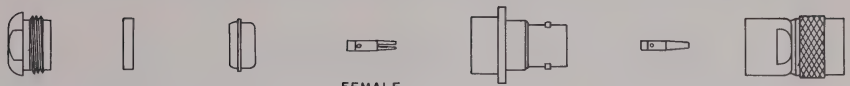
⑧ ALL WIRING NO. 22 AWG FOR RUNS UP TO 50 FEET EXCEPT POWER LEADS (BP 25-30). POWER LEADS REQUIRE NO. 20 AWG.

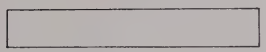
⑨ TO OPERATE BLOWER CONNECT PIN BP 31 TO BP 28 WITH EXTERNAL JUMPER.

⑩ 860E-2 DME RANGES TO 288 MILES WHEN SO EQUIPPED AND OVERIDEN. OVERRIDE MAY BE ALSO ACCOMPLISHED BY GROUNDING BP 19.

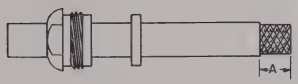
Figure 416. 860E-2 Distance Measuring Equipment, Interconnecting Wiring Diagram


JUNCTION BOX
313N-2/3/4D CONTROL UNIT
614U-7/8 CONTROL UNIT
BP 1
BP 2
BP 3
BP 4
BP 5
BP 6
BP 7
BP 8
BP 9
BP 18
BP 19
19
32
38
39
40
41
42
43
44
35
45
46
AUDIO SYSTEM
115 VAC
115 VAC
27.5 VDC
2372-1 ANTENNA
TO OTHER EQUIPMENT
TACAN AZIMUTH INFORMATION

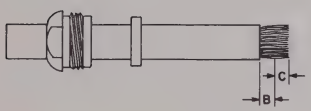




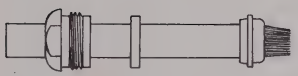
TYPE NUMBER	A	B	C	D
570-U, 571-U, 573-U 625-U, 629-U, 630-U	9/32	1/8	5/32	1/16
627-U, 631-U	3/8	7/32	5/32	5/32
628-U, 632-U	19/32	7/16	5/32	11/32



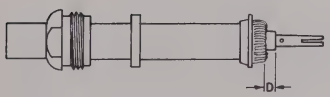
PLACE NUT AND GASKET OVER CABLE AND CUT JACKET TO DIMENSION "A". DO NOT NICK BRAID.



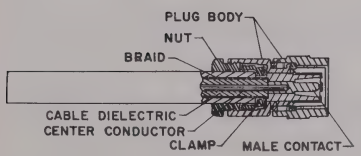
COMB OUT BRAID AND FOLD OUT. CUT CABLE DIELECTRIC TO DIMENSION "B". DO NOT NICK CONDUCTOR.



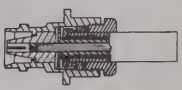
PULL BRAID WIRES FORWARD AND TAPER TOWARD CENTER CONDUCTOR. PLACE CLAMP OVER BRAID AND PUSH BACK AGAINST CABLE JACKET.



FOLD BACK BRAID WIRES AS SHOWN, TRIM TO PROPER LENGTH AND FORM OVER CLAMP AS SHOWN. SOLDER CONTACT TO CENTER CONDUCTOR. DIMENSION "D" SHOULD BE AS SHOWN.

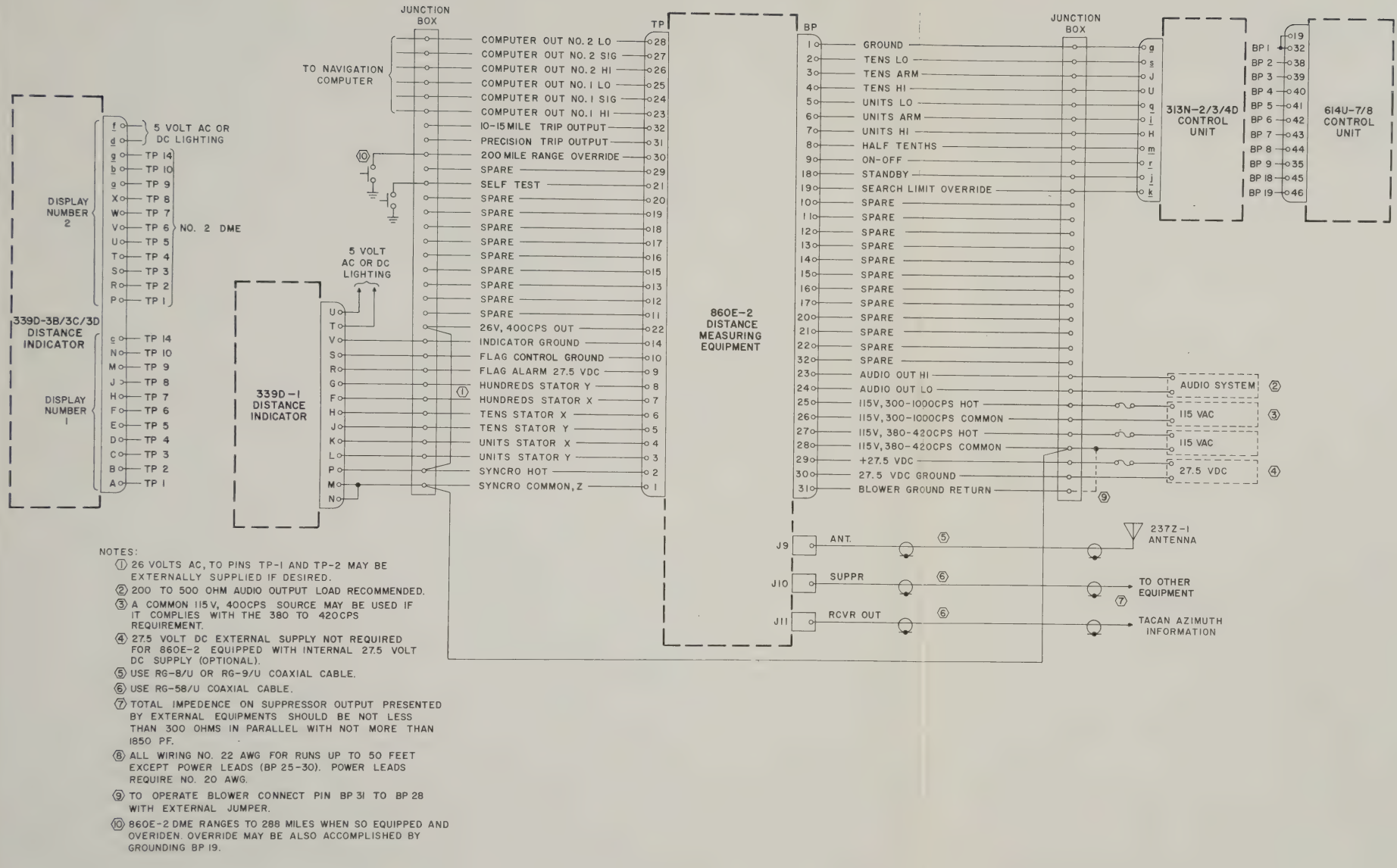


INSERT CABLE AND PARTS INTO CONNECTOR BODY. MAKE SURE SHARP EDGE OF CLAMP SEATS PROPERLY IN GASKET. TIGHTEN NUT. END OF CONTACT IN PLUG SHOULD BE FLUSH WITH INSULATOR. THERE SHOULD BE A CLEARANCE OF .010 BETWEEN END OF CONTACT AND INSULATOR IN JACK.



MATING PART

UG-573A/U to RG-8/U Assembly
Figure 417



NOTES:

① 26 VOLTS AC, TO PINS TP-1 AND TP-2 MAY BE EXTERNALLY SUPPLIED IF DESIRED.

② 200 TO 500 OHM AUDIO OUTPUT LOAD RECOMMENDED.

③ A COMMON 115 V, 400CPS SOURCE MAY BE USED IF IT COMPLIES WITH THE 380 TO 420CPS REQUIREMENT.

④ 27.5 VOLT DC EXTERNAL SUPPLY NOT REQUIRED FOR 860E-2 EQUIPPED WITH INTERNAL 27.5 VOLT DC SUPPLY (OPTIONAL).

⑤ USE RG-8/U OR RG-9/U COAXIAL CABLE.

⑥ USE RG-58/U COAXIAL CABLE.

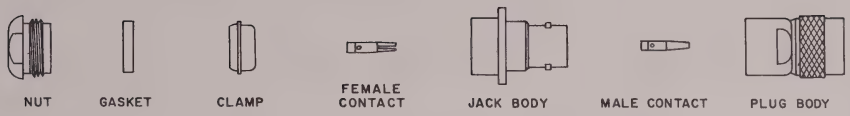
⑦ TOTAL IMPEDENCE ON SUPPRESSOR OUTPUT PRESENTED BY EXTERNAL EQUIPMENTS SHOULD BE NOT LESS THAN 300 OHMS IN PARALLEL WITH NOT MORE THAN 1850 PF.

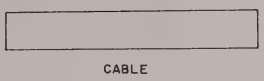
⑧ ALL WIRING NO. 22 AWG FOR RUNS UP TO 50 FEET EXCEPT POWER LEADS (BP 25-30). POWER LEADS REQUIRE NO. 20 AWG.

⑨ TO OPERATE BLOWER CONNECT PIN BP 31 TO BP 28 WITH EXTERNAL JUMPER.

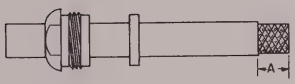
⑩ 860E-2 DME RANGES TO 288 MILES WHEN SO EQUIPPED AND OVERIDEN. OVERRIDE MAY BE ALSO ACCOMPLISHED BY GROUNDING BP 19.

Figure 416. 860E-2 Distance Measuring Equipment, Interconnecting Wiring Diagram

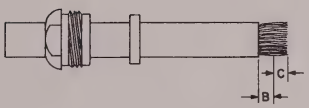




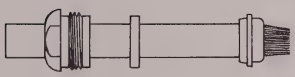
TYPE NUMBER	A	B	C	D
570-U, 571-U, 573-U 625-U, 629-U, 630-U	9/32	1/8	5/32	1/16
627-U, 631-U	3/8	7/32	5/32	5/32
628-U, 632-U	19/32	7/16	5/32	11/32



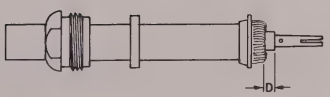
PLACE NUT AND GASKET OVER CABLE AND CUT JACKET TO DIMENSION "A". DO NOT NICK BRAID.



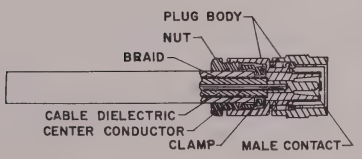
COMB OUT BRAID AND FOLD OUT. CUT CABLE DIELECTRIC TO DIMENSION "B". DO NOT NICK CONDUCTOR.



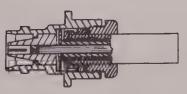
PULL BRAID WIRES FORWARD AND TAPER TOWARD CENTER CONDUCTOR. PLACE CLAMP OVER BRAID AND PUSH BACK AGAINST CABLE JACKET.



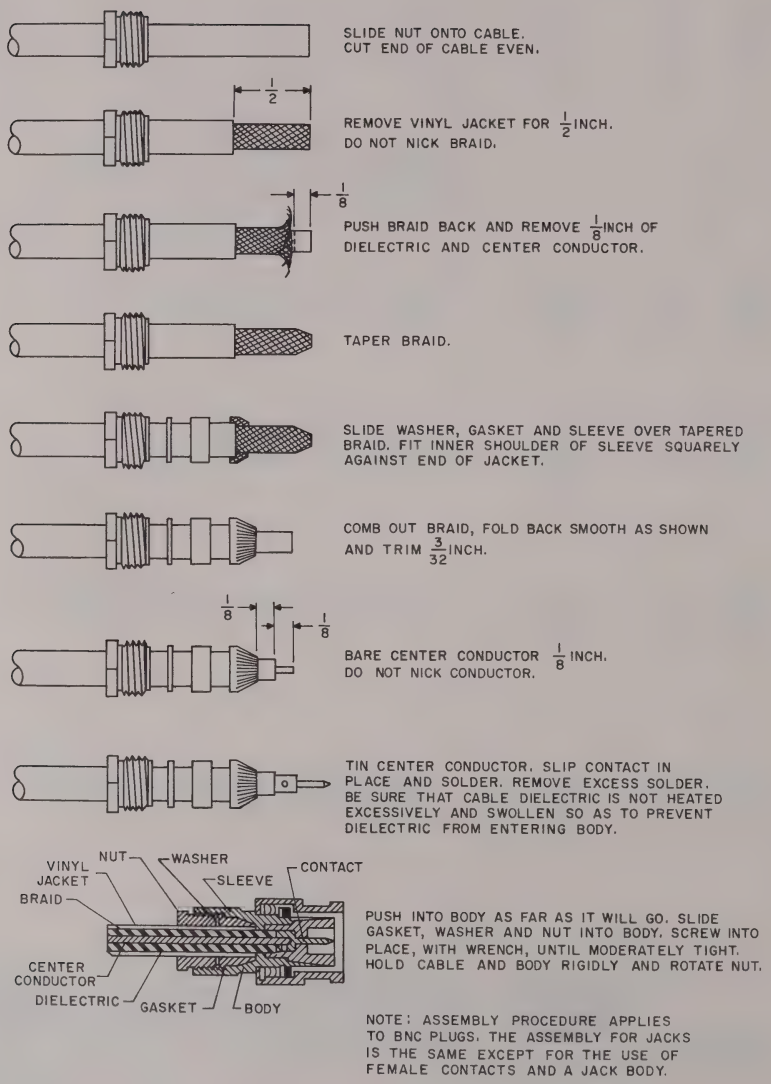
FOLD BACK BRAID WIRES AS SHOWN, TRIM TO PROPER LENGTH AND FORM OVER CLAMP AS SHOWN. SOLDER CONTACT TO CENTER CONDUCTOR. DIMENSION "D" SHOULD BE AS SHOWN.



INSERT CABLE AND PARTS INTO CONNECTOR BODY. MAKE SURE SHARP EDGE OF CLAMP SEATS PROPERLY IN GASKET. TIGHTEN NUT. END OF CONTACT IN PLUG SHOULD BE FLUSH WITH INSULATOR. THERE SHOULD BE A CLEARANCE OF .010 BETWEEN END OF CONTACT AND INSULATOR IN JACK.



UG-573A/U to RG-8/U Assembly
Figure 417


SLIDE NUT ONTO CABLE.
CUT END OF CABLE EVEN.
1/2
REMOVE VINYL JACKET FOR 1/2 INCH.
DO NOT NICK BRAID.
1/8
PUSH BRAID BACK AND REMOVE 1/8 INCH OF
DIELECTRIC AND CENTER CONDUCTOR.
TAPER BRAID.
SLIDE WASHER, GASKET AND SLEEVE OVER TAPERED
BRAID. FIT INNER SHOULDER OF SLEEVE SQUARELY
AGAINST END OF JACKET.
COMB OUT BRAID, FOLD BACK SMOOTH AS SHOWN
AND TRIM 3/32 INCH.
1/8
1/8
BARE CENTER CONDUCTOR 1/8 INCH.
DO NOT NICK CONDUCTOR.
TIN CENTER CONDUCTOR. SLIP CONTACT IN
PLACE AND SOLDER. REMOVE EXCESS SOLDER.
BE SURE THAT CABLE DIELECTRIC IS NOT HEATED
EXCESSIVELY AND SWOLLEN SO AS TO PREVENT
DIELECTRIC FROM ENTERING BODY.
VINYL JACKET
NUT
WASHER
SLEEVE
CONTACT
BRAID
CENTER CONDUCTOR
DIELECTRIC
GASKET
BODY
PUSH INTO BODY AS FAR AS IT WILL GO. SLIDE
GASKET, WASHER AND NUT INTO BODY. SCREW INTO
PLACE, WITH WRENCH, UNTIL MODERATELY TIGHT.
HOLD CABLE AND BODY RIGIDLY AND ROTATE NUT.
NOTE: ASSEMBLY PROCEDURE APPLIES
TO BNC PLUGS. THE ASSEMBLY FOR JACKS
IS THE SAME EXCEPT FOR THE USE OF
FEMALE CONTACTS AND A JACK BODY.

UG-88/U to RG-58/U Assembly
Figure 418

860E-2 Distance Measuring Equipment - Adjustment/Test

1. ADJUSTMENT PROCEDURES.

No attempt to adjust or align the 860E-2 should be made while it is installed in an aircraft. If the 860E-2 is malfunctioning, it should be taken to appropriate overhaul facilities and aligned and tested per the 860E-2 Distance Measuring Equipment, Overhaul Manual, Collins part number 523-0755913.

2. RAMP TESTING PROCEDURES.

The following procedure assumes that a standard location for the 475D-1 Ramp Test Set and a standard setting for the 475D-1 T/R ATTEN DB control have not been previously determined for the particular aircraft installation being tested. If the standard location and control setting have been determined omit the procedures in paragraph A and proceed with paragraph B.

A. Calibration Procedures for 475D-1 T/R ATTEN DB.

The T/R ATTEN DB selector of the 475D-1 provides compensation for difference radiation path losses encountered in operation. The 475D-1 is calibrated to provide proper output and sensitivity levels at a distance of approximately 50 feet from a typical airline-type aircraft DME antenna installation with the T/R ATTEN DB selector set at the 15 position. Installations using general aviation type DME units will require approximately 15 db less attenuation. Use the following procedure to determine the correct T/R ATTEN DB setting for a particular aircraft antenna installation with a particular location of the 475D-1 relative to the aircraft. Once the correct T/R ATTEN DB setting and test set location have been determined, it may be used for subsequent tests of similar installations.

After suitable location and T/R ATTEN DB setting have been established, a diagram should be drawn for future reference. The diagram should show the exact location and distance from the aircraft. One diagram will be required for each type of aircraft and/or type DME antenna installation.

NOTE: This procedure should be done with an aircraft that has a known good DME installation and an 860E-2 known to meet performance specifications.

(1) Self-test the 475D-1 in accordance with instructions contained within the cover of the 475D-1.

(2) Turn the 475D-1 FUNCTION SELECTOR switch to the AUTO 5-180 position.

(3) Set the T/R ATTEN DB control of the 475D-1 to 25.

(4) Enter the aircraft and move the DME control to T/R (DME).

(5) Adjust the frequency controls of the DME control unit to 109.0 megacycles as indicated in the FREQ MC (NAV) window.

NOTE: This frequency corresponds to DME channel 27. If a different channel is used in the 475D-1, adjust the DME control unit frequency controls to the associated VOR/ILS frequency. See figure 407.

(6) Position the DME control to OVERRIDE (OVRD) position.

(7) Check for presence of a tone signal in the headset or cabin speaker. If there is none, reduce the 475D-1 T/R ATTEN DB setting one step at a time until the tone signal is noted and the distance indicator in the aircraft instrument panel indicates the search mode of operation and subsequent lock-on at 5 miles or 180 miles.

NOTE: If proper operation cannot be obtained at any setting of the T/R ATTEN DB control, move the 475D-1 closer to the aircraft antenna and repeat step (7).

(8) Record the T/R ATTEN DB setting found in step (7) as a standard for subsequent measurements of identical aircraft installations.

B. Test Procedure (Preferred).

NOTE: This test procedure assumes that the 475D-1 has been modified per 475D Service Bulletin No. 2. If the 475D-1 has not been modified, use the alternate procedure listed under paragraph C.

(1) Place the 475D-1 in the previously determined standard location with the test set antenna (open side of cover) facing the aircraft DME antenna.

(2) Self-test the 475D-1 in accordance with the instructions contained within the cover of the test set.

(3) Connect the 475D-1 pendant antenna cable (in right compartment) to the r-f jack (J503).

(4) Set the 475D-1 T/R ATTEN-DB control to the standard setting for the aircraft installation being tested. Set the FUNCTION SELECTOR to AUTO 5-180.

(5) Enter the aircraft and perform the following checks:

(a) Aircraft master power switch to ON.

(b) DME control unit to T/R and OVERRIDE (OVRD).

(c) DME control set to 475D-1 channel (normally 109.0 mc).

(d) Allow 860E-2 to warm up for three minutes.

(6) Check for presence of identification tone signal in headset or cabin speaker.

(7) Check that the flag of the distance indicator is pulled completely out of view when the 860E-2 is locked on and in view when searching.

(8) Check that the 860E-2 alternately locks on at 5 miles and approximately 180 miles. With 475D-1 units without the tracking speed check, the accuracy tolerance should be ±0.2 miles at 5 miles and ±2.2 miles at 180 miles at approximately 2 seconds after lock-on. Disregard the distance drift which begins approximately 2 seconds after lock-on when the DME is in the velocity memory period. With 475D-1 units with the tracking speed check, the above holds true for the 5-mile lock-on, however, at the 180-mile lock-on the distance will be sweeping between approximately 171 miles and 189 miles at a rate of about 1000 knots, and lock-on and tracking will occur within this range.

(9) While the 860E-2 is locked on at 5 miles, position the DME control to NORM (DME). The 860E-2 will then loose lock, search, and lock-on again at 5 miles, then repeat the cycle unless the 860E-2 is a model with TVOR channels always overridden. If the 860E-2 has TVOR channels permanently overridden, the 860E-2 will cycle between locking on at 5 miles and locking on at 180 miles.

C. Test Procedure (Alternate).

NOTE: This test procedure is to be used when the 475D-1 has not been modified per 475D Service Bulletin No. 2.

(1) Place the 475D-1 in the previously determined standard location with the test set antenna (open side of cover) facing the aircraft DME antenna.

(2) Self-test the 475D-1 in accordance with the instructions contained within the cover of the test set.

(3) Connect the 475D-1 pendant antenna cable (in right compartment) to the r-f jack (J503).

(4) Set the 475D-1 T/R ATTEN-DB control to the standard setting for the aircraft installation being tested. Set the FUNCTION SELECTOR to 180 miles.

(5) Enter the aircraft and perform the following checks:

(a) Aircraft master power switch to ON.

(b) DME control unit to T/R and OVERRIDE (OVRD).

(c) DME control set to 475D-1 channel, (normally 109.0 mc).

(d) Allow 860E-2 to warm up for three minutes.

(6) Check for presence of identification tone signal in headset or cabin speaker.

(7) Check that the flag of the distance indicator is pulled completely out of view when the 860E-2 is locked on and in view when searching.

(8) Check that the 860E-2 locks on at 180 ±2.2 miles.

(9) Position the DME control to NORM (DME).

(10) Check that the 860E-2 searches outbound from 0 miles to the range limit and then slews inbound to 0 miles and repeats ten cycles without locking on, unless the 860E-2 is a model with TVOR channels always overridden.

(11) Turn the 475D-1 FUNCTION SELECTOR switch to 5 MI.

(12) Check that the 860E-2 locks on at 5 ±0.2 miles.

860E-2 Distance Measuring Equipment - Inspection/Check

1. INSPECTION PROCEDURES.

A. Check that the 349D-3B Shockmount is properly fastened to the airframe and is grounded.

B. Check that the 860E-2 is securely fastened to the 349D-3B.

C. Check each unit of the DME system for damage to finish.

D. Check cabling for signs of wear, broken wires or bad connections.

E. Check that all equipment dust covers are in place.

F. Check all viewing glass for scratches, chipped or broken surfaces, and cleanliness.

G. Check all electrical connections. Tighten the locking rings if required.

860E-2 Distance Measuring Equipment - Cleaning/Painting

1. GENERAL.

No cleaning or painting is required or recommended while the equipment is installed in the aircraft. Approved cleaning procedures should be performed when the equipment is removed from the aircraft as described in the 860E-2 Distance Measuring Equipment, Overhaul Manual, Collins part number 523-0755913.

860E-2 Distance Measuring Equipment - Approved Repairs

1. GENERAL.

No repairs should be attempted on the DME system while the equipment is installed in the aircraft. Complete overhaul instructions are furnished in the 860E-2 Distance Measuring Equipment, Overhaul Manual, Collins part number 523-0755913.

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